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CATALOGUE

OF THE

FOSSIL CEPHALOPODA

IN THE

DEPARTMENT OF GEOLOGY.

PART III.

BIBLIOTHECA
REGIA
MONACENSIS

CATALOGUE

OF THE

FOSSIL CEPHALOPODA

IN THE

BRITISH MUSEUM

(NATURAL HISTORY).

PART III.

CONTAINING THE

BACTRITIDÆ,

AND PART OF THE SUBORDER

AMMONOIDEA.

BY

ARTHUR H. FOORD, PH.D. (Münch.), F.G.S.,

AND

GEORGE CHARLES CRICK, Assoc. R.S.M., F.G.S.

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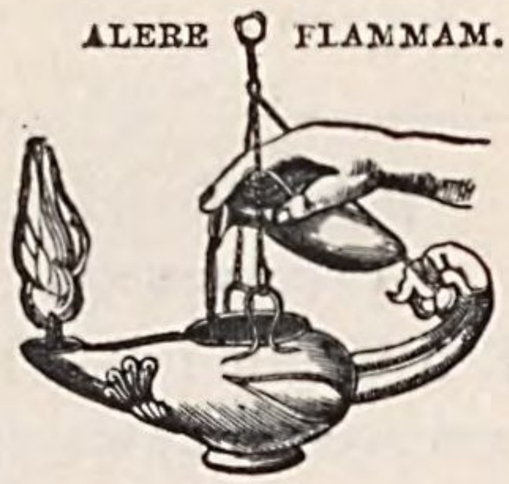
BIBLIOTHECA
REGIA
MONACENSIS



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PREFACE.

When Dr. A. H. Foord, the original Author of this Catalogue, was reluctantly obliged to leave London and take up his residence in Ireland, owing to his appointment to the Royal Dublin Society, he expressed the wish that the name of his fellow-worker, Mr. G. C. Crick, might be associated with his own in this volume. By far the larger share of the work of completing it has indeed fallen upon Mr. Crick, who remains on the spot with all the specimens, needing constantly to be referred to, in his immediate charge.

It is most satisfactory to be able to state, that, with the exception of the delay in the completion of Part III., due to the above-mentioned cause, the Catalogue itself has not otherwise suffered loss; for Dr. Foord, although at a distance, has rendered all the assistance possible, in order to carry the work through the press.

The interest attaching to the Goniatites as the direct ancestors of the Ammonites, and the conclusive evidence which the former afford of their almost imperceptible passage into the latter, will render this volume extremely important to all those who desire to study the phylogeny of this group.

HENRY WOODWARD.

Geological Department,
April 21st, 1897.

INTRODUCTION.

During the lapse of time in which descriptions of extensive collections of fossils, such as those of the British Museum, are being prepared for publication, changes of greater or less importance may be expected to be made in their classification. Probably in no group have such important changes been made as in that of the Ammonoidea, which have long been subjected to a process of sifting and rearranging at the hands of almost every systematist who has dealt with them.

Of the three groups (*Bactritidæ*, *Clymenidæ*, and the Goniatites) which are treated of in the following pages, the changes made chiefly concern the Goniatites. Each of the two former groups is represented by one genus only, and the views respecting these groups have therefore been incorporated with the observations appended to these genera.

It may, however, be of interest to give a brief *résumé* of some of the most important works that have dealt with the division of the Goniatites.

The name *Goniatites* was proposed in 1825 by De Haan[1], who defined the group as follows :—"Testa septata, septis angulatis vel linguatis, spiralis: anfractibus plane involutis." The two species which he referred to this genus were *Goniatites sphæricus* (J. Sowerby) and *Goniatites striatus* (J. Sowerby)[2].

In his paper 'Ueber Goniatiten,' L. v. Buch[3] divided the Goniatites into (i) those with rounded lobes, and (ii) those with pointed lobes; and each of these sections he again divided into (i) those having a simple

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[1] Monogr. Ammonit. et Goniat. p. 39.

[2] Both these forms are now referred to Hyatt's genus *Glyphioceras*. If therefore the name *Goniatites* is to be retained in a restricted sense it must replace the name *Glyphioceras*; but, so far as we are aware, the name has not been used in this restricted sense by any author.

[3] Phys. Abhandl. d. k. Akad. d. Wissensch. Berlin for 1830, pp. 159–187 (1832). [Read Dec. 15, 1831.]

dorsal [= external] lobe, and (ii) those having a divided dorsal [= external] lobe. This classification was also reproduced by the same author somewhat later[1].

In his work 'Ueber die Planuliten und Goniatiten im Uebergangs-Kalk des Fichtelgebirges' (1832), Münster divided the Goniatites as follows:—

(i) With simple, feebly curved and rounded lobes.
(ii) With pointed or linguiform lobes.
  (*a*) Quite involute, with only one pointed infundibuliform lobe.
  (*b*) Quite involute, with two lateral lobes.
  (*c*) Not involute, with three lateral lobes.
(iii) Doubtful species.

In the 'Nachtrag zu den Goniatiten des Fichtelgebirges,' which is contained in the first edition of Heft i. of his 'Beiträge zur Petrefacten-Kunde' (1839), additional species of Goniatites are described and this classification is somewhat extended. It is as follows:—

(i) With simple, feebly curved and rounded lobes. Completely involute.
(ii) With pointed or linguiform lobes.
  A. Quite involute.
    (*a*) With only one pointed infundibuliform lateral lobe.
    (*b*) With two lateral lobes.
  B. Not involute.
    (*a*) With only one lateral lobe.
    (*b*) With two lateral lobes.
    (*c*) With three lateral lobes.
    (*d*) With four lateral lobes.
(iii) Doubtful species.

This classification is also reproduced in the 2nd edition of Heft i. of the same author's 'Beiträge zur Petrefacten-Kunde' (1843).

In 1837, in his work entitled 'De Goniatitis in montibus rhenanis occurrentibus' (pp. 16–18), Beyrich instituted the following groups of Goniatites based upon the form of the suture-line:—(i) *Nautilini*: (ii) *Simplices*—(*a*) with deep rounded lateral lobe; (*b*) with acute infundibuliform lateral lobe; (*c*) with acute linguiform lateral lobe: (iii) *Æquales*—(*a*) lateral lobes increasing with the suture-line; (*b*) lateral lobes decreasing with the suture-line: (iv) *Irregulares*: (v) *Primordiales*: (vi) *Carbonarii*.

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[1] Neues Jahrbuch, 1832, p. 221.

At a later date Bronn [1] added to these the group *Indivisi* for such forms as *Goniatites rotatorius*, de Koninck.

In his 'Cephalopoden' (1846) F. A. Quenstedt divided the Goniatites into (*a*) *Subnautilini* (those with a simple external lobe), and (*b*) *Subammonii* (those with a divided external lobe).

In their memoir on 'Die Versteinerungen des rheinischen Schichtensystems in Nassau' (1850–56), the Bros. G. & F. Sandberger founded the following groups of Goniatites upon the structure of the suture-line:—(i) *Linguati*; (ii) *Lanceolati* (=*Æquales* p. p., Beyrich); (iii) *Genufracti* (=*Carbonarii*, Beyrich); (iv) *Serrati* (=*Irregulares*, Beyrich); (v) *Crenati* (=*Primordiales*, Beyrich); (vi) *Acutolaterales*; (vii) *Magnosellares* (= *Simplices*, Beyrich); (viii) *Nautilini* (= *Nautilini*, Beyrich).

J. Barrande (Syst. Sil. de la Bohême, vol. ii., 1867) included in the family *Goniatidæ* the genera *Goniatites* and *Bactrites*, the former of which he divides into (*a*) *Nautilini*, and (*b*) an undetermined group comprising the species *Goniatites emaciatus*.

In 1877 Meek (U.S. Geol. Surv. 40th Parallel, vol. iv. pt. i. p. 99) proposed the subgeneric name *Agoniatites* for the *Nautilini* of earlier authors.

Dr. Paul Fischer (Manuel de Conchyliologie, fasc. iv., 1882) divides the Ammonea (=Ammonoidea of other authors) into eleven families, the first being the *Goniatitidæ*, containing *Clymenia* and *Goniatites*. He enumerates the subdivisions of the latter proposed by Beyrich, Bronn, and by the Bros. Sandberger; and states that "it is probable that the principal groups of Ammonites are derived from corresponding groups of the Goniatites which will shortly be distinguished by generic names."

Mojsisovics [2], however, made the first attempt to divide the Goniatites into a number of distinct genera and to indicate their relationship with certain Ammonite-groups. Thus, among the Nautilini he recognized two genera—(i) *Anarcestes*, including the forms with a long body-chamber, and (ii) *Aphyllites*, comprising those with a short body-chamber. The former he regarded as giving rise to the *Arcestidæ*, and the latter, together with *Prolecanites*, as being the origin of the *Lytoceratinæ*. For Barrande's *Goniatites emaciatus* from the Lower Devonian he proposed the name *Pinacites*, on account of its relationship with *Pinacoceras*, and upon Keyserling's *Goniatites*

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[1] Lethaea geogn. vol. i. p. 516 (1851–56).

[2] "Die Cephalopoden der Mediterranen Triasprovinz," Abhandl. d. k.-k. geol. Reichsanst., Wien, vol. x. (1882).

acutus, also an ancestor of the *Pinacoceratinæ*, he founded the genus *Timanites*. For *Gon. princeps* and *Gon. virgatus*, belonging to von Buch's *Carbonarii*, he proposed the genus *Pericyclus*, and the name *Pronorites* for a small group of Carboniferous species bearing to *Norites* the same relation that *Prolecanites* does to the Triassic genus *Lecanites*.

But the first attempt at anything like a complete classification of the Goniatites we owe to Prof. Alpheus Hyatt, who regarded the Goniatites as forming a suborder (*Goniatitinæ*) of the Ammonoidea, and divided them into the following families and genera :—

NAUTILINIDÆ, Hyatt.

Mimoceras, Hyatt. Type, *Ammonites compressus*, H. E. Beyrich, De Goniatitis in montibus rhenanis occurrentibus, 1837, p. 5, pl. i. f. 6.

Anarcestes, Mojsisovics. Type, *Goniatites plebeius*, J. Barrande, Syst. Sil. de la Bohême, vol. ii. 1867, p. 37, pl. v. ; pl. vi. ; pl. vii. ff. 3–9, 12, 13 ; pl. ccxli. ff. 6–8 ; pl. ccxlii. ff. 2–10.

Heminautilinus, Hyatt. Type, *Goniatites hybridus*, G. Münster, Ueber Planul. & Goniat. 1832, p. 19, pl. iii. ff. 6 *a*, *b*, *c*.

Agoniatites, Meek. Type, *Goniatites expansus*, L. Vanuxem, Nat. Hist. N. York, Pt. IV. Geology, Pt. iii. Third Geol. District, 1842, p. 146, f. 1.

Pinacites[1], Mojsisovics. Type, *Goniatites emaciatus*, J. Barrande, Syst. Sil. de la Bohême, vol. ii. 1867, p. 43, pl. iii. ff. 1–6 ; pl. xii. ff. 1–3.

Celaeceras, Hyatt. Type, *Goniatites praematurus*, J. Barrande, Syst. Sil. de la Bohême, vol. ii. Suppl. 1877, p. 110, pl. dxxii. ff. 1–4.

PRIMORDIALIDÆ, Hyatt.

Gephuroceras[2], Hyatt. Type, *Goniatites sinuosus*, J. Hall, Nat. Hist. N. York, Pt. VI. Palæont., vol. v. pt. 2, 1879, p. 460, pl. lxx. ff. 13–15 ; pl. lxxii. f. 11 ; pl. lxxiv. f. 11.

Manticoceras, Hyatt. Type, *Goniatites simulator*, J. Hall, Nat. Hist. N. York, Pt. VI. Palæont., vol. v. pt. 2, 1879, p. 453, pl. lxix. ff. 1, 2 ; pl. lxxiv. f. 8.

MAGNOSELLARIDÆ, Hyatt.

Parodiceras, Hyatt. Type, *Goniatites discoideus*, J. Hall, Thirteenth Rep. N. York State Cab. Nat. Hist. 1860, pp. 97, 98, woodc. 3–6 ; and Nat. Hist. N. York, Pt. VI. Palæont., vol. v. pt. 2, 1879, p. 441, pl. lxxi. ff. 1–13 ; pl. lxxiv. ff. 3, 4.

Tornoceras, Hyatt. Type, *Goniatites uniangularis*, T. A. Conrad, Journ. Acad. Nat. Sci. Philadelphia, vol. viii. 1842, p. 268, pl. xvi. f. 4 ; J. Hall, Nat. Hist. N. York, Pt. VI. Palæont., vol. v. pt. 2, p. 444, pl. lxxi. f. 14 ; pl. lxxii. ff. 6, 7 ; pl. lxxiv. f. 2.

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[1] Spelt *Pinnacites* by Hyatt.

[2] *Gephyroceras* of subsequent authors.

Maeneceras, Hyatt. Type, *Goniatites terebratus*[1], G. & F. Sandberger, Verstein. rhein. Schichtensyst. Nassau, 1850–56, p. 55, pl. v. ff. 3 *a–d*.

Sporadoceras, Hyatt. Type, *Goniatites bilanceolatus*, G. & F. Sandberger, Verstein. rhein. Schichtensyst. Nassau, 1850–56, p. 71, pl. viii. ff. 11, 11 *a–d* (named *G. bidens* on the plate).

GLYPHIOCERATIDÆ, Hyatt.

Brancoceras, Hyatt. Type, *Goniatites Ixion*, J. Hall, Thirteenth Rep. N. York State Cab. Nat. Hist. 1860, p. 125, woodc. ff. 1–3; and Nat. Hist. N. York, Pt. VI. Palæont., vol. v. pt. 2, 1879, p. 474, pl. lxxiii. ff. 12–14; pl. lxxiv. f. 12.

Munsteroceras, Hyatt. Type, *Goniatites Oweni*, var. *parallelus*, J. Hall, Nat. Hist. N. York, Pt. VI. Palæont., vol. v. pt. 2, 1879, p. 470, pl. lxxiii. ff. 3–8; pl. lxxiv. f. 9.

Gastrioceras, Hyatt. Type, *Goniatites Listeri*, J. Phillips, Geol. Yorks. pt. ii. 1836, p. 235, pl. xx. f. 1.

Paralegoceras, Hyatt. Type, *Goniatites Iowensis*, F. B. Meek & A. H. Worthen, Proc. Acad. Nat. Sci. Philadelphia, 1860, p. 471.

Prionoceras, Hyatt. Type, *Goniatites divisus*, G. Münster, Ueber Planul. & Goniat. 1832, p. 24, pl. iv. ff. 6 *a–d*.

Glyphioceras, Hyatt. Types, Sect. i., *Goniatites crenistria*, J. Phillips, Pal. Foss. Cornwall, Devon, &c. 1841, p. 121, pl. l. ff. 234 *a–g*. Sect. ii., *Goniatites obtusus*, J. Phillips, Geol. Yorks. pt. ii. 1836, p. 234, pl. xix. ff. 10–11 (? 13).

Dimeroceras, Hyatt. Type, *Goniatites mamillifer*, G. & F. Sandberger, Verstein. rhein. Schichtensyst. Nassau, 1850–56, p. 70, pl. v. ff. 5, 5 *a–c*.

Pericyclus, Mojsisovics. Type, *Ammonites princeps*, L. G. de Koninck, Descr. Anim. Foss. 1842–44, p. 579, pl. li. ff. 2, 3; *Goniatites princeps*, L. G. de Koninck, Faune Calc. Carb. de la Belgique (Ann. Mus. Roy. d'Hist. nat. de Belgique, sér. Paléont. vol. v.), pt. ii. 1880, p. 116, pl. xlix. ff. 1, 2.

Homoceras, Hyatt. Type, *Goniatites calyx*, J. Phillips, Geol. Yorks. pt. ii. 1836, p. 236, pl. xx. ff. 22, 23.

Nomismoceras, Hyatt. Type, *Goniatites spirorbis*, J. Phillips, Geol. Yorks. pt. ii. 1836, p. 237, pl. xx. ff. 51–55.

Dimorphoceras, Hyatt. Type, *Goniatites Gilbertsoni*, J. Phillips, Geol. Yorks. pt. ii. 1836, p. 236, pl. xx. ff. 27–31.

PROLECANITIDÆ, Hyatt.

Sandbergeoceras[2], Hyatt. Type, *Goniatites tuberculoso-costatus*, G. & F. Sandberger, Verstein. rhein. Schichtensyst. Nassau, 1850–56, p. 64, pl. v. ff. 1, 1 *a–f*.

Beloceras, Hyatt. Type, *Ammonites multilobatus*, E. Beyrich, De Goniatitis in rhenanis montibus occurrentibus, 1837, p. 9, pl. i. f. 9.

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[1] See footnote, p. 121.

[2] Should be *Sandbergeroceras*.

Medlicottia, Waagen. Type, *Goniatites Orbignyanus*, E. de Verneuil, in Murchison, de Verneuil, & de Keyserling, Géol. Russie d'Europe, vol. ii. 1845, p. 575, pl. xxvi. ff. 6 *a*, *b*, *c*.

Sageceras, Mojsisovics. Type, *Goniatites Haidingeri*, Haidinger's Naturw. Abhandl. vol. i. 1847, p. 264, pl. viii. ff. 9–11.

Lobites, Mojsisovics. Type is not stated, but the species first mentioned under this genus is *Goniatites pisum*, G. Münster, Beiträge zur Petrefacten-Kunde, iv. 1841, p. 127, pl. xiv. ff. 6 *a*, *b*, *c*.

Prolecanites, Mojsisovics. Type, *Goniatites mixolobus*, G. & F. Sandberger, Verstein. rhein. Schichtensyst. Nassau, 1850–56, p. 67, pl. iii. ff. 13, 13 *a*, *b* (*not* pl. ix. ff. 6, 6 *a*).

Pharciceras, Hyatt. Type, *Goniatites tridens*, G. & F. Sandberger, Verstein. rhein. Schichtensyst. Nassau, 1850–56, p. 66, pl. iv. ff. 2, 2 *a–e*.

Schistoceras, Hyatt. Type. Neither figured nor described.

Triainoceras, Hyatt. Type, *Goniatites costatus*, d'Archiac and de Verneuil, Trans. Geol. Soc. [2], vol. vi. 1842, p. 340, pl. xxxi. ff. 1, 1 *a*.

Pronorites, Mojsisovics. Type, *Goniatites cyclolobus* (Phillips), C. Barrois, Bol. Com. Map. geol. España, vol. viii. 1881, p. 138, pl. C. ff. 2 *a–c*.

Popanoceras, Hyatt. Type, *Goniatites Kingianus*, E. de Verneuil, in Murchison, de Verneuil, & de Keyserling, Géol. Russie d'Europe, vol. ii. 1845, p. 374, pl. xxvii. ff. 5 *a*, *b*, *c*.

In his 'Handbuch der Palæontologie,' Bd. ii., Prof. Dr. K. A. von Zittel gives a summary of Hyatt's divisions, some of which, however, he regards as synonyms. His classification of the Goniatites is as follows :—

Nautilinidæ, Hyatt. (*Nautilini*, Beyrich.)
Mimoceras, Hyatt.
Anarcestes, Mojsisovics.
Agoniatites, Meek.
Pinacites, Mojsisovics.
Celaeceras, Hyatt.

Primordialidæ, Hyatt. (*Primordiales*, Beyrich, and *Crenati*, Sandb.)
Gephyroceras, Hyatt. (*Manticoceras*, Hyatt, *Timanites*, Mojsisovics.)

Magnosellaridæ, Hyatt. (*Magnosellares*, Sandb., *Acutolaterales*, Sandb., *Simplices* p.p. and *Æquales*, Beyrich.)
Parodiceras and *Tornoceras*, Hyatt.

Maeneceras, Hyatt. (*Acutolaterales*, Beyrich.)
Sporadoceras, Hyatt. (*Æquales*, Beyrich.)

Glyphioceratidæ, Hyatt. (*Carbonarii*, Beyrich, *Simplices* p.p., Beyrich, *Genufracti*, Sandb., and *Indivisi*, Bronn.)
Prionoceras and *Brancoceras*, Hyatt.
Dimeroceras, Hyatt.
Pericyclus, Mojsisovics.
Glyphioceras, Hyatt. (*Münsteroceras*, *Homoceras*, *Nomismoceras*, Hyatt.)
Dimorphoceras, Hyatt.
Gastrioceras, Hyatt.

Prolecanitidæ, Hyatt. (*Lanceolati*, *Linguati*, *Serrati*, Sandb.; *Irregulares*, Beyrich.)
Sandbergeroceras, Hyatt. (*Linguati*, Sandb.)
Pharciceras, Hyatt.
Prolecanites, Mojsisovics. (*Lanceolati*, Sandb., *Æquales* p.p., Beyrich.)
Schistoceras, Hyatt.
Triainoceras, Hyatt.
Pronorites, Mojsisovics.
Popanoceras, Hyatt.
Beloceras, Hyatt. (*Serrati*, Sandb., *Irregulares*, Beyrich.)

Hyatt included in the Prolecanitidæ also the genera *Medlicottia*, Waagen; *Sageceras*, Mojsisovics; and *Lobites*, Mojsisovics. Zittel places the last-named in the *Arcestidæ*, and the others in the *Pinacoceratidæ*.

Steinmann and Döderlein ('Elemente der Paläontologie,' pt. ii. pp. 373 *et seqq.*) refer the genera *Goniatites* and *Clymenia* to the family *Goniatitidæ*, which they subdivide as follows:—

Fam. GONIATITIDÆ.

GONIATITES.

i. **Anarcestinæ.**

Anarcestes, Mojsisovics.
Tornoceras, Hyatt.

a. **Paucilobati.**

Brancoceras, Hyatt.
Glyphioceras, Hyatt.

b. **Multilobati.**

Sporadoceras, Hyatt.

ii. **Mimoceratinæ.**

Bactrites, Sandb.
Mimoceras, Hyatt.
Agoniatites, Hyatt.

a. **Compressus**-series.

Pharciceras, Hyatt.
Prolecanites, Mojsisovics.
Pronorites, Mojsisovics.

b. **Evexus**-series.

Beloceras, Hyatt.

c. **Primordialis**-series.

Manticoceras, Hyatt.
Gephyroceras, Hyatt.

CLYMENIA.

A. **Nautiliniformes.**

Oxyclymenia, Gümbel.

B. **Primordialiformes.**

Cymaclymenia, Gümbel.

C. **Serratiformes.**

Goniaclymenia, Gümbel.

In his 'Grundzüge der Palæontologie,' 1895, Prof. Dr. K. A. v. Zittel divides the Ammonoidea into two sections, (A) Intrasiphonata, and (B) Extrasiphonata. The Intrasiphonata include only one family, viz. the *Clymeniidæ*, and this contains only the genus *Clymenia*, Münster, with four subgenera (a) *Cyrtoclymenia*, (b) *Oxyclymenia*, (c) *Cymaclymenia*, (d) *Gonioclymenia*.

The Extrasiphonata embrace the rest of the Ammonoidea. These are divided into fifteen families, the first two of which, viz., *Goniatitidæ* and *Prolecanitidæ*, embrace the Goniatites. These are subdivided as follows:—

Goniatitidæ, v. Buch (emend. Zitt.).

Bactrites, Sandb.
Anarcestes, Mojs.
Mimoceras, Hyatt.
Aphyllites, Mojs. (*Agoniatites*, Meek.)
Pinacites, Mojs.
Tornoceras, Hyatt. (*Parodiceras*, Hyatt.)
Brancoceras, Hyatt. (*Prionoceras*, Hyatt.)
Gephyroceras, Hyatt. (*Manticoceras*, Hyatt; *Timanites*, Mojs.)
Glyphioceras, Hyatt. (*Münsteroceras*, *Homoceras*, Hyatt.)
Nomismoceras, Hyatt.
Pericyclus, Mojs.

Gastrioceras, Hyatt.
Maeneceras, Hyatt.
Sporadoceras, Hyatt.
Ibergiceras, Karpinsky.

PROLECANITIDÆ, Hyatt.
Prolecanites, Mojs. (*Pharciceras*, Hyatt.)
Sandbergeroceras, Hyatt. (*Triainoceras*, Hyatt.)
Doryceras, Gemmellaro [1].
Clinolobus, Gemm.
? *Lecanites*, Mojs.
Pronorites, Mojs.
Daraelites, Gemm.
Norites, Mojs.
Parapronorites, Gemm.
Sicanites, Gemm.
Propinacoceras, Gemm.
Medlicottia, Waagen.
Agathiceras, Gemm. (*Adrianites*, Gemm.)
Sageceras, Mojs.
Longobardites, Mojs.
Beloceras, Hyatt.

Besides the works which have dealt with the Classification of the Goniatites as a whole, there have been several memoirs treating on the Goniatites from particular horizons, or with particular genera of Goniatites.

Tschernyschew [2], in his memoir on 'Die Fauna des mittleren und oberen Devon am West-Abhange des Urals,' uses Hyatt's genera, e. g. *Manticoceras*, *Tornoceras*, and *Parodiceras*, in a subgeneric sense for the Goniatites which he records; Frech, in his papers on 'Die Paläozoischen Bildungen von Cabrières (Languedoc)' [3] and the 'Geologie der Umgegend von Haiger bei Dillenburg (Nassau),' [4] and Maurer in his 'Nachträge zur Fauna und Stratigraphie der Orthoceras-Schiefer des Rupbachthales,' [5] similarly use Hyatt's genera for the various Goniatites which they record and describe.

In a work on the "Céphalopodes de la section supérieure du Calcaire carbonifère de la Russie centrale," Marie Tzwetaev [6] gives

[1] See *infrà*, p. xvi.
[2] Mém. Com. géol. St. Pétersbourg, vol. iii. no. 3 (1887).
[3] Zeitschr. deutsch. geol. Gesell. vol. xxxix. 1887, pp. 360–488.
[4] Abhandl. geol. Specialkarte Preussen &c. vol. viii. 3 (1888).
[5] Neues Jahrb. Beil. Bd. x. pp. 613–756 (1896).
[6] Mém. Com. géol. St. Pétersbourg, vol. v. no. 3 (1888).

a list of the species referable to the genus *Gastrioceras*, and describes a new species (*G. russiense*) of this genus.

In his memoir entitled 'La Fauna dei calcari con fusulina nella valle del fiume Sosio,' G. G. Gemmellaro[1] instituted several new genera of Ammonoidea, and grouped the Cephalopod fauna of these Permian beds as follows:—Arcestidæ—(i) *Waagenoceras*, Gemm.; (ii) *Hyattoceras*, Gemm.; s. g. *Abichia*, Gemm.; (iii) *Popanoceras*, Hyatt; (iv) *Stacheoceras*, Gemm.; (v) *Adrianites*, Gemm.; s. g. *Hoffmannia*, Gemm. Pinacoceratidæ—(i) *Medlicottia*, Waagen; (ii) *Propinacoceras*, Gemm.; (iii) *Parapronorites*, Gemm.; (iv) *Sicanites*, Gemm. Ptychitidæ—*Daraelites*, Gemm. Tropitidæ—(i) *Thalassoceras*, Gemm.; (ii) *Paraceltites*, Gemm. Prolecanitidæ—(i) *Agathiceras*, Gemm.; (ii) *Doryceras*, Gemm.; (iii) *Clinolobus*, Gemm. Glyphioceratidæ—(i) *Gastrioceras*, Hyatt; (ii) *Glyphioceras*, Hyatt.

This fauna shows how imperceptibly the Goniatites pass into the Ammonites; a few only of the forms would be considered as Goniatites, the great majority being closely allied to Triassic Ammonites, which are now so well known through the elaborate works of E. v. Mojsisovics and others.

A. Karpinsky[2], in his excellent work 'Ueber die Ammoneen der Artinsk-Stufe und einige mit denselben verwandte carbonische Formen,' makes some very valuable observations on the genera which are represented in these beds, and classifies them as follows:—Prolecanitidæ, Hyatt.—(i) *Pronorites*, E. v. Mojsisovics; (ii) *Parapronorites*, Gemmellaro; (iii) *Medlicottia*, Waagen; s. g. *Propinacoceras*, Gemmellaro. Glyphioceratidæ, Hyatt.—(i) *Gastrioceras*, Hyatt; (ii) *Glyphioceras*, Hyatt; (iii) *Paralegoceras*, Hyatt. Arcestidæ, E. v. Mojsisovics.—(i) *Agathiceras*, Gemmellaro; (ii) *Popanoceras*, Hyatt. Fam. indet.—(i) *Thalassoceras*, Gemmellaro; (ii) *Paraceltites*, Gemmellaro.

In his memoir[3] on 'Die Cephalopoden-führenden Kalke des unteren Carbon von Erdbach-Breitscheid bei Herborn,' E. Holzapfel makes some important remarks on the classification of the Goniatites, particularly with reference to the genera *Brancoceras*, Hyatt;

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[1] Giorn. Sci. Nat. ed Econ. vol. xix. 1888, pp. 1–106, pls. A, 1–10.

[2] Mém. Acad. Imp. Sci. St. Pétersbourg, [7], vol. xxxvii. no. 2, 1889. Dr. Emil Haug reviewed this paper in the Ann. Géol. Univ. 1889, vol. vi. (1890), pp. 818–822.

[3] Palæont. Abhandl., Dames and Kayser, vol. v. 1 (1889). Dr. Emil Haug reviewed this paper in the Ann. Géol. Univ. 1889, vol. vi. (1890), pp. 814–818. (See *infrà* p. 13, footnote.)

Glyphioceras, Hyatt (including *Glyphioceras*, *Münsteroceras*, *Homoceras*, and *Nomismoceras* (*pars*), Hyatt); *Nomismoceras*, Hyatt; *Pericyclus*, v. Mojsisovics; *Dimorphoceras*, Hyatt; and *Prolecanites*, Mojsisovics.

In a paper on Carboniferous Cephalopods which appeared in the 2nd Annual Report of the Geological Survey of Texas for 1890 (1891), pp. 329–356, Prof. Hyatt makes some additional observations on the genus *Gastrioceras*, and describes a new species (*Gastr. compressum*), and in his second paper on the Carboniferous Cephalopods (Fourth Ann. Rep. Geol. Surv. Texas for 1892 (1893), pp. 379–474) the same author describes from Texas two new species of *Glyphioceras* (*G. Cumminsi* and *G. incisum*), and records the occurrence there of *Gastrioceras entogenum*? (Gabb) and *Paralegoceras iowense* (Meek and Worthen).

Besides the critical reviews of the memoirs of Holzapfel and Karpinsky, which appeared in the 'Annuaire géologique universel' for 1889 (vol. vi. pp. 814–822), Dr. Emile Haug[1] published in 1894 a paper on the classification of the Ammonites of the Permian and of the Trias.

In addition to his work on 'Die Cephalopoden der Mediterranen Triasprovinz,'[2] already referred to, E. v. Mojsisovics, in his later works on the 'Arktische Triasfaunen'[3] and 'Die Cephalopoden der Hallstätter Kalke,'[4] indicates the origin of certain Triassic genera of Ammonites from Carboniferous and Permo-Carboniferous Ammonoidea. Waagen's memoirs[5] on the fossils from the Salt Range of India must also be mentioned.

In his work entitled 'Das obere Mitteldevon (Schichten mit *Stringocephalus Burtini* und *Maeneceras terebratum*) im Rheinischen Gebirge' (Abhandl. d. k. Preuss. geol. Landesanst., n. f., Heft 16, 1895), E. Holzapfel deals in an exhaustive manner with the Cephalopod fauna of these beds, the Goniatites being represented by the genera *Agoniatites*, Meek, with two species and several varieties; *Anarcestes*, Mojsisovics, with six species; *Tornoceras*, Hyatt, with nine species; and *Maeneceras*, Hyatt, with four species. The author also offers some remarks on *Prolecanites clavilobus*, G. & F.

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[1] "Les Ammonites du Permien et du Trias: Remarques sur leur classification," Bull. Soc. Géol. France, [3], vol. xxii. pp. 385–412 (1894).

[2] Abhandl. d. k.-k. geol. Reichsanst., Wien, vol. x. (1882).

[3] Mém. Acad. Imp. Sci. St. Pétersbourg, [7], vol. xxxiii. no. 6 (1886).

[4] Abhandl. d. k.-k. geol. Reichsanst., Wien, vol. vi. pt. ii. (1893).

[5] Mem. Geol. Surv. India.—Pal. Indica, ser. xiii. vol. i. 1887; vol. ii. 1895.

Sandberger, as well as upon *Goniatites Höninghausi*, v. Buch, *G. Höninghausi*, d'Archiac & de Verneuil, and *G. multiseptatus*, v. Buch. As, however, some of the present Catalogue was already in type when this work appeared, we were not able to incorporate the author's observations on some of the species of *Agoniatites*, *Anarcestes*, and *Tornoceras*.

The genus *Prolecanites* has been specially dealt with by Karpinsky in a paper entitled 'Sur l'existence du genre *Prolecanites* en Asie et sur son développement' [1].

An important memoir by J. P. Smith on 'Marine Fossils from the Coal Measures of Arkansas' (Proc. Amer. Philos. Soc. vol. xxxv. 1896, pp. 213–285) came to hand after the whole of the present volume of the Catalogue was in type, so that we have not been able to insert references to the several species of Ammonoidea therein described. These belong to the genera *Gastrioceras*, *Paralegoceras*, and *Pronorites*.

The foundation of the present classification of the Ammonoidea was laid by Prof. Hyatt [2], whose work is universally recognized as containing the elements of a natural system of classification, which in the main has been adopted in the present volume, but we have incorporated the results of subsequent work on the subject.

A slight difference will be observed between the arrangement of the matter contained in the first 32 pages and the rest of the book. After these earlier pages had been printed, it was considered advisable to adopt the plan pursued in the other (contemporary) catalogues of the Geological Department and to print the number of each specimen conspicuously, with its history, whenever known. Furthermore, a uniform plan has been pursued in describing the species, which will be applied to all the Ammonoidea, whereby each character is taken in the same order throughout, thus greatly facilitating comparisons between the species. The following is the plan of description [3]:—

General form of shell; thickness; height of outer whorl. Number of whorls; amount of inclusion; umbilicus. Whorl—transverse section; amount of indentation; periphery; sides; inner area. Length of body-chamber; form of aperture. Depth of chambers;

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[1] Bull. Acad. Imp. Sci. St. Pétersbourg, [5], vol. iv. no. 2 (1896).

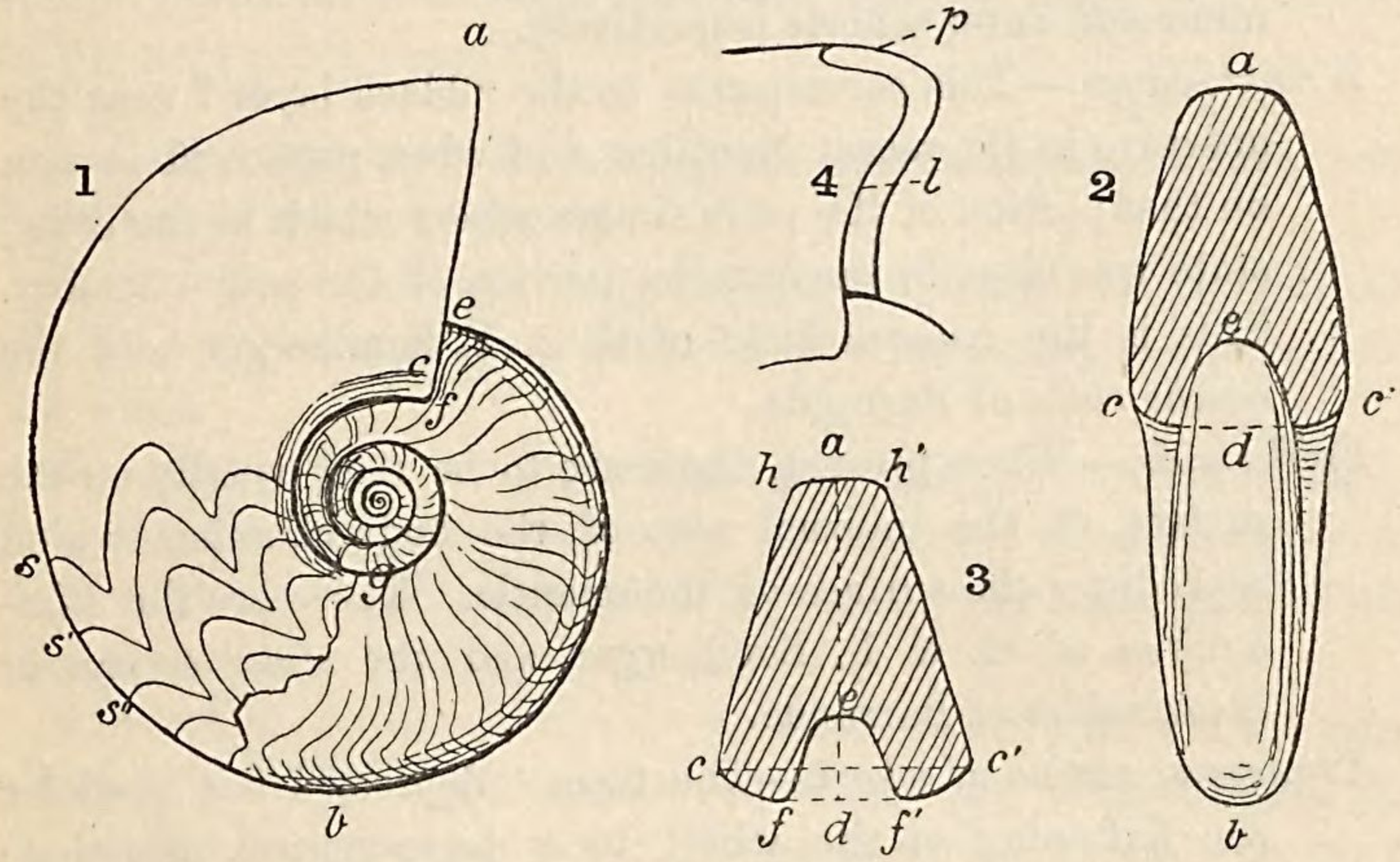
[2] 'Genera of Fossil Cephalopods," Proc. Boston Soc. Nat. Hist. vol. xxii. pp. 253–338 (1883–84).

[3] This plan of description was commenced before some of the terms suggested by Prof. Hyatt in his 'Phylogeny of an acquired Characteristic' had been published.

number to a whorl; suture-line. Test. Initial-chamber or proto-conch. Wrinkle-layer and epidermids.

The following diagram illustrates the various terms employed in the descriptions:—

Fig. A.



(1) Lateral and (2) front view of an Ammonoid shell.—*ab*, diameter; *cc'*, thickness; *ad*, height of outer whorl; *de*, amount of inclusion when expressed in terms of the height of the inner whorl, and amount of indentation when expressed in terms of the height of the outer whorl; *f*, suture of shell; *fg*, width of umbilicus; *c*, umbilical margin ('umbilical shoulder or angle' of *Hyatt*); *as*, body-chamber; distance between *s* and *s'*, *s'* and *s''*, depth of chambers; *s*, *s'*, *s''*, suture-lines or septal sutures. (3) Transverse section of whorl.—*ad*, height; *cc'*, width; *de*, amount of indentation; *hh'*, periphery ('venter' of *Hyatt*); *h*, *h'*, margins of periphery ('abdominal angles' of *Hyatt*); *hc*, side or lateral area; *c*, *c'*, umbilical margin ('umbilical shoulder or angle' of *Hyatt*); *cf*, inner area ('umbilical zone' of *Hyatt*); *fef'*, impressed zone; the area *cfef'c'* is the 'dorsum' of *Hyatt*. (4) Lateral aspect of aperture.—*l*, lateral sinus; *p*, peripheral sinus ('hyponomic sinus' of *Hyatt*, so called because it is due to the large size of the hyponome or motor organ usually called "fleshy funnel" in the modern nautilus). Prof. Hyatt uses the terms "crest" for projecting parts, and "sinus" for inflections of the outline of the aperture, to distinguish them from the saddles and the lobes of the suture-line.

Amount of inclusion.—The portion (*de*) of the penultimate whorl that is covered by the outer whorl; it is expressed in terms of the height of the inner whorl at the greatest diameter of the shell. Thus inclusion three-fourths means that three-fourths of the height of the penultimate whorl is covered by the outer whorl.

Amount of indentation.—The height (*de*) to which the outer whorl is indented by the preceding whorl; it is expressed in terms of the height of the outer whorl. Thus the amount of inclusion and the amount of indentation are represented by the same quantity expressed in terms of the height of the inner and outer whorls respectively.

Wrinkle-layer.—This corresponds to the "black layer" near the aperture in the recent Nautilus, and when preserved is seen on that portion of the penultimate whorl which in the living state was close to the anterior portion of the body-chamber. This is the *Runzelschicht* of G. & F. Sandberger and the *couche ridée* of Barrande.

Epidermids.—When present, these are to be seen usually on the surface of the internal cast of the body-chamber which reproduces the surface of the mantle. These are the *Ritz-streifen* of G. & F. Sandberger and the *stries creuses* or *épidermides* of Barrande.

Transverse section of whorl.—The term "depressed" is used for the flattening of the whorl in a dorso-ventral direction; "compressed" when the flattening takes place from side to side. When the sides of the whorl are inclined inwardly towards the umbilicus, Prof. Hyatt speaks of them as being "divergent"; "convergent" when they incline outwardly towards the periphery. Thus in fig. A 3 the whorl is "compressed" and the sides are "convergent."

Whenever possible, the specific characters have been drawn up from the type-specimen, unless it was certain that this was an immature specimen, and that the adult could be recognized in the Collection. In order to avoid a long and usually unsatisfactory description, we have reproduced the suture-line for each species. Whenever possible this has been carefully traced (and, if necessary, enlarged) by one of us from an actual example, if possible from the type-specimen. In figs. 73 *et seqq.* the dotted line indicates the position of the umbilical margin (*c*, fig. A) and the short terminal line the position of the suture of the shell (*f*, fig. A). In many species, chiefly those that are very involute, it has been difficult to ascertain the exact number of the whorls.

Many specimens, and unfortunately several of the types, are stated to have come from the Carboniferous Limestone or simply from the Carboniferous without any horizon being given. We have, however, given the specific characters as fully as possible, hoping

that the species may thereby be easily recognized and their exact horizon recorded, so that the presence or absence of life-zones in the Carboniferous may thus become apparent.

We have endeavoured to give the principal references to each species—that is, those references which concern either the locality or the name of the species.

In conclusion, we desire to express our obligations to those who have assisted us in our work.

To Dr. Woodward we are particularly indebted for the valuable advice that he has ever been ready to give us during the progress of the work.

To Messrs. Newton, Sharman, and Allen, of the Museum of Practical Geology, Jermyn Street, we tender our best thanks for their courtesy in affording us every facility for the study of the specimens under their charge.

Our cordial thanks are due to Mr. B. B. Woodward for the valuable help that he has given us in the bibliography of the subject, and we are also indebted to Mr. C. Davies Sherborn for allowing us to make free use of his MS. Index Animalium.

With the exception of a few drawings which were made by one of us, the illustrations were most carefully prepared by Miss G. M. Woodward, to whom we desire to express our sincere thanks.

We are also indebted to Mr. Bolton, of the Manchester Museum, Owens College, for sending us from time to time specimens for study.

ARTHUR H. FOORD.
GEORGE C. CRICK.

Geological Department,
April 21st, 1897.

SYSTEMATIC INDEX

OF

GENERA AND SPECIES.

[*Note.*—New species are indicated thus * ; new names thus †.]

Page

Family BACTRITIDÆ 1

Bactrites 1

—— carinatus 8, 283

—— Büdesheimensis 10

—— Ausavensis 10

—— obliquiseptatus? 11

—— (?) Steinhaueri 11

Suborder **AMMONOIDEA** 13

Family CLYMENIDÆ 14

Clymenia 14, 283

—— angustiseptata? 18

—— binodosa 20

—— lævigata 21

—— undulata 23

—— striata 27

—— speciosa 29

—— subarmata 31

—— paradoxa 32

Page

Family NAUTILINIDÆ 33
Mimoceras 33, 283
—— compressum 35
—— ambigena 37
Anarcestes 38, 284
—— lateseptatus 38, 284
—— simulans 41
—— neglectus 41
—— Noeggerati 42
—— subnautilinus 44
—— Ruppachensis 45
—— cancellatus 47, 284
—— nuciformis 48
—— sp. 284
Agoniatites 49, 284
—— Bohemicus 49
—— fidelis 50
—— verna 51
—— occultus 52
—— tabuloides 53
—— fecundus 54
—— transitorius 55
—— obliquus 56
—— Vanuxemi 57
—— costulatus 285
—— verna-rhenanus 286

Family PRIMORDIALIDÆ 59
Gephyroceras 59, 287
—— forcipifer ? 61
—— intumescens 62, 287
—— lamellosum 69
—— sublamellosum 71
—— complanatum 72
—— orbiculus 75, 287
—— retrorsum 78
—— bisulcatum 80
—— Koeneni 81
—— affine 82

Page

Family PRIMORDIALIDÆ (*continued*).

Gephyroceras calculiforme 84
—— æquabile 87
—— serratum 88
—— planorbis 90
—— Keyserlingi 288
—— acutum 289
—— Uchtense 290

Family MAGNOSELLARIDÆ 91
Tornoceras 91, 291
—— undulosum 92
—— globosum 94
—— lineare 96
—— Verneuili 97
—— subpartitum 99
—— circumflexum 100
—— acutum 101
—— auris 103
—— Ausavense 106
—— simplex 107, 291
—— Sandbergeri † 112
—— planidorsatum 113
—— subundulatum 114
—— ——, var. falcata 115
—— circumflexiferum 116
—— (?) aratum 117
—— Hughesii 118
—— psittacinum 119
—— Whidbornei * 120
—— curvispina 292
Maeneceras 121
—— terebratum 123
—— molarium 124
—— intermedium * 125
—— apertum * 126
Sporadoceras 127
—— Muensteri 128
—— subbilobatum 130

	Page
Family GLYPHIOCERATIDÆ	131
Brancoceras	131
—— divisum	133
—— sulcatum	135
—— subsulcatum	136
—— quadripartitum	137
—— Belvalianum	138
—— rotatorium	139
—— Ixion	141
—— sp.	142
—— sp.	142
Pericyclus	143
—— princeps	145
—— virgatus ?	146
—— funatus	147
—— fasciculatus	148
—— furcatus	149
—— Doohylensis *	151
—— sp.	152
Glyphioceras	153
—— sphæricum	157
—— crenistria	160
—— fimbriatum *	165
—— striatum	166
—— obtusum	169
—— Phillipsi *	172
—— micronotum	173
—— truncatum	175
—— vesica	178, 293
—— implicatum	180
—— mutabile	181
—— platylobum	183
—— stenolobum	184
—— nitidum	186
—— Oweni	188
—— parallelum	189
—— hispanicum *	190

Page

Family GLYPHIOCERATIDÆ (*continued*).

Glyphioceras sp. 191
—— bilingue 192
—— reticulatum 193
—— Davisi * 198
—— excavatum 199
—— bidorsale 201
—— diadema 202
—— calyx 206
—— complicatum 208
—— (?) paucilobum 209
—— spirale 210
—— sp. 211
Nomismoceras 212
—— spirorbis 213
—— rotiforme 215
—— vittiger 217
—— ornatum * 218
Dimorphoceras 219
—— Gilbertsoni 220
—— discrepans 222
—— Looneyi 224
—— carina 225
Gastrioceras 226
—— carbonarium 229
—— Listeri 233
—— coronatum * 236
—— Marianum 237
—— Jossæ 239
—— Suessi 240

Family PROLECANITIDÆ 242
Sandbergeroceras 242
—— tuberculoso-costatum 244
Prolecanites 244
—— lunulicosta 247
—— tridens 248

Page

Family PROLECANITIDÆ (*continued*).

Prolecanites Becheri 249
—— ceratitoides 251
—— compressus 252
—— mixolobus 254
—— discoides * 256
—— serpentinus 257
—— similis 259
Pronorites 260
—— postcarbonarius 262
—— præpermicus 263
—— cyclolobus 264, 293
Medlicottia 265
—— Artiensis 267
Agathiceras 268
—— Uralicum 270
—— (?) micromphalum 271
Beloceras 273
—— sagittarium 274

APTYCHI 277
INDETERMINABLE GONIATITES 278
INCERTÆ SEDIS 279
SUPPLEMENT 283

LIST OF ILLUSTRATIONS.

Page

Fig. A. Diagram of an Ammonoid xix

1. Apex of Nautiloids; initial-chamber of Ammonoids, of *Belemnites*, and of *Spirula* 4
2. Clymenia speciosa. *Structural* 15
3. Clymenia angustiseptata, C. striata, C. binodosa, C. lævigata, C. speciosa, C. subarmata. *Suture-lines* . 18
4. Clymenia undulata 26
5. Mimoceras compressum; Anarcestes lateseptatus?; A. Noeggerati; Agoniatites Bohemicus 34
6. Mimoceras ambigena. *Suture-line* . . . 38
7. Anarcestes lateseptatus. „ . . . 39
8. „ simulans. „ . . . 41
9. „ neglectus. „ . . . 42
10. „ subnautilinus. „ . . . 45
11. „ Ruppachensis. „ . . . 46
12. „ cancellatus. „ . . . 47
13. „ nuciformis. „ . . . 48
14. Agoniatites Bohemicus. „ . . . 50
15. „ fidelis. „ . . . 51
16. „ verna. „ . . . 52
17. „ occultus. „ . . . 53
18. „ tabuloides. „ . . . 53
19. „ fecundus. „ . . . 54
20. „ transitorius. „ . . . 55
21. „ obliquus. „ . . . 57
22. „ Vanuxemi. „ . . . 58
23. Gephyroceras intumescens. „ . . . 60
24. „ forcipifer? „ . . . 61
25. „ intumescens; Tornoceras simplex . . 69

				Page
Fig. 26.	Gephyroceras lamellosum.	*Suture-line* . . .		70
27.	„ sublamellosum.	„ . . .		71
28.	„ complanatum.	„ . . .		73
29.	„ orbiculus.	„ . . .		76
30.	„ retrorsum ?	„ . . .		79
31.	„ bisulcatum.	„ . . .		80
32.	„ Koeneni.	„ . . .		81
33.	„ affine.	„ . . .		83
34.	„ calculiforme.	„ . . .		85
35.	„ æquabile.	„ . . .		87
36.	„ serratum.	„ . . .		89
37.	„ planorbis.	„ . . .		90
38.	Tornoceras uniangulare.	„ . . .		91
39.	„ undulosum.	„ . . .		93
40.	„ globosum.	„ . . .		95
41.	„ lineare.	„ . . .		97
42.	„ Verneuili.	„ . . .		98
43.	„ subpartitum.	„ . . .		100
44.	„ circumflexum.	„ . . .		101
45.	„ acutum.	„ . . .		102
46.	„ auris.	„ . . .		104
47.	„ Ausavense.	„ . . .		107
48.	„ simplex.	„ . . .		109
49.	„ Sandbergeri.	„ . . .		112
50.	„ planidorsatum.	„ . . .		114
51.	„ subundulatum.	„ . . .		115
52.	„ ——, *var.* falcata.	„ . . .		116
53.	„ circumflexiferum.	„ . . .		116
54.	„ Hughesii.	„ . . .		118
55.	„ psittacinum.	„ . . .		119
56.	„ Whidbornei.	„ . . .		120
57.	Maeneceras terebratum			121
58.	„ molarium.	*Suture-line* . . .		125
59.	„ apertum.	„ . . .		126
60.	Sporadoceras Muensteri			127
61.	„ subbilobatum.	*Suture-line* . . .		131
62.	Brancoceras Ixion			132

				Page
Fig. 63.	Brancoceras divisum.	*Suture-line*	. . .	134
64.	„ sulcatum.	„	. . .	135
65.	„ subsulcatum.	„	. . .	136
66.	„ quadripartitum.	„	. . .	137
67.	„ Belvalianum.	„	. . .	139
68.	Pericyclus princeps		. . .	144
69.	„ virgatus.	*Suture-line*	. . .	144
70.	„ princeps.	„	. . .	145
71.	„ furcatus		. . .	150
72.	„ Doohylensis		. . .	151
73.	Glyphioceras sphæricum		. . .	154
74.	„ micronotum.	*First whorl*	. . .	156
75.	„ sphæricum.	*Suture-line*	. . .	159
76.	„ crenistria.	„	. . .	161
77.	„ fimbriatum		. . .	165
78.	„ striatum.	*Suture-line*	. . .	168
79.	„ obtusum.	„	. . .	170
80.	„ Phillipsi.	„	. . .	172
81.	„ micronotum.	„	. . .	174
82.	„ truncatum.	„	. . .	176
83.	„ vesica?	„	. . .	178
84.	„ implicatum.	„	. . .	180
85.	„ mutabile.	„	. . .	182
86.	„ platylobum		. . .	183
87.	„ stenolobum		. . .	185
88.	„ nitidum.	*Suture-line*	. . .	187
89.	„ Oweni.	„	. . .	188
90.	„ parallelum.	„	. . .	189
91.	„ hispanicum		. . .	190
92.	„ sp.	*Suture-line*	. . .	191
93.	„ bilingue.	„	. . .	192
94.	„ reticulatum.	„	. . .	194
95.	„ Davisi		. . .	198
96.	„ excavatum.	*Suture-line*	. . .	200
97.	„ bidorsale.	„	. . .	201
98.	„ diadema		. . .	203
99.	„ complicatum.	*Suture-line*	. . .	208
100.	„ (?) paucilobum.	„	. . .	209

			Page
Fig. 101.	Glyphioceras spirale.	*Suture-line* . . .	210
102.	Nomismoceras spirorbis		212
103.	„ rotiforme.	*Suture-line* . . .	216
104.	„ ornatum		219
105.	Dimorphoceras Gilbertsoni		221
106.	„ discrepans.	*Suture-line* . . .	223
107.	„ Looneyi.	„ . . .	224
108.	"Goniatites" carina.	„ . . .	225
109.	Gastrioceras Jossæ		227
110.	„ carbonarium		230
111.	„ Listeri		234
112.	„ coronatum		236
113.	„ Marianum.	*Suture-line* . . .	238
114.	„ Suessi.	„ . . .	241
115.	Sandbergeroceras tuberculoso-costatum		243
116.	Prolecanites compressus; P. mixolobus		245
117.	„ lunulicosta.	*Suture-line* . . .	247
118.	„ tridens.	„ . . .	249
119.	„ Becheri.	„ . . .	250
120.	„ ceratitoides.	„ . . .	251
121.	„ compressus		253
122.	„ discoides		256
123.	„ serpentinus.	*Suture-line* . . .	258
124.	„ similis.	„ . . .	260
125.	Pronorites cyclolobus		261
126.	„ postcarbonarius.	*Suture-line* . . .	262
127.	„ præpermicus.	„ . . .	263
128.	Medlicottia Orbignyana.	„ . . .	266
129.	„ Artiensis.	„ . . .	268
130.	Agathiceras Suessi		269
131.	„ Uralicum.	*Suture-line* . . .	270
132.	„ (?) micromphalum.	„ . . .	272
133.	Beloceras sagittarium		275
134.	Gephyroceras intumescens with Aptychus *in situ* .		277
135.	Aptychus of Goniatite		277
136.	„ „		277
137.	„ „		278

			Page
Fig. 138.	Aptychus of Goniatite		278
139.	Subclymenia evoluta		282
140.	Agoniatites costulatus.	*Suture-line*	285
141.	„ verna-rhenanus.	„	286
142.	Gephyroceras Keyserlingi.	„	288
143.	„ acutum.	„	290
144.	„ Uchtense.	„	291
145.	Tornoceras curvispina.	„	292

CORRIGENDA ET ADDENDA.

Page 10, line 13 from bottom, insert the letter C before the number 3464 *a–g*.
„ 30, line 16 from top, for *subcarinata* read *subcarinatus*.
„ 90, line 11 from top and line 8 from bottom, for **planorbe** read **planorbis.**
„ 93, line 1, *delete* comma after the word *retrorsus*.
„ 102, lines 5 and 6, *delete* this reference ; see *infrà*, p. 289.
„ 138, line 12 from top, for *Belvalianum* read *Belvalianus*.

CATALOGUE

OF

FOSSIL CEPHALOPODA.

[*MACROCHOANITES*[1] (*Transitiones*), Hyatt.]

Family BACTRITIDÆ[2], Hyatt[3].

Genus **BACTRITES,** G. Sandberger[4].

(*Orthoceratites*, Blumenbach, 1803[5]; *Orthocera*, J. Sowerby, 1814[6]; *Orthoceratites*, Münster, 1840[7]; *Orthoceratites*, Keyserling, 1846[8];

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[1] Proposed by Hyatt "to include *Bactrites* and such straight forms as are transitional to *Ammonoidea* and all the *Nautilinidæ* [=*Mimoceras*, *Anarcestes*, and other genera of *Goniatites*], and also the *Clymeninæ*, which have similar long funnels" [= septal necks].—"Genera of Fossil Cephalopods," Proceed. Boston Soc. Nat. Hist. 1884, vol. xxii. p. 260. See also *infrà*, p. 3.

[2] There being only a single genus (*Bactrites*) in this family, the characters of the latter are not given, as they are included in those of the genus.

[3] "Genera of Fossil Cephalopods," Proc. Boston Soc. Nat. Hist. 1884, vol. xxii. p. 303.

[4] Neues Jahrbuch für Min. &c. 1841, p. 240, where *Bactrites* is described but not named. The name was conferred in a memoir on the fossils of Nassau, contained in the 'Amtlicher Bericht über die zwanzigste Versammlung der Gesell. deutsch. Naturforsch. und Aerzte zu Mainz,' 1843, p. 157.

[5] Specimen Archæologiæ Telluris, p. 21.

[6] Min. Conch. vol. i. p. 132.

[7] Beiträge zur Petrefactenkunde, (iii.) p. 100.

[8] Wissensch. Beobacht. auf eine Reise im das Petschora-Land, im Jahre 1843, p. 271.

Orthoceratites, Quenstedt, 1849 [1]; *Melia* (pars), d'Orbigny (non Fischer de Waldheim), 1849 [2]; *Stenoceras*, d'Orbigny, 1849 [3]; *Orthoceratites*, Steininger, 1853 [4]; ? *Trematoceras*, Eichwald, 1860 [5]; *Orthoceras*, Blake, 1882 [6].)

Gen. Char. Shell straight, elongate-conical, sometimes cylindrical, sometimes flattened upon the sides, giving the section an elliptical form. Sutures simple; the dorsal lobe short, obtusely angular, sometimes inconspicuous, but always with a distinct boundary-line. The lateral lobe almost disappears in species with a rounded section, but in those with an elliptical section it forms a rounded angle, directed backwards. Siphuncle marginal, thin, filiform. Necks of the septa funnel-shaped, *i. e.* enlarging in front and contracted behind. Transverse striæ forming a backwardly-directed sinus upon the dorsal side. Initial chamber or protoconch erect, egg-shaped, without scar (Branco [7]).

Cambrian ?, Ordovician, Devonian, Carboniferous [8].

Remarks. The above description is taken mainly, though not entirely, from that of the brothers Sandberger [9], who further observe that the form of the lobes in *Bactrites* shows a remarkable resemblance to that of *Goniatites* [*Mimoceras*] *compressus*.

G. Sandberger [10], in his earlier description of the genus *Bactrites*, suggested that the relationship between the latter and *Goniatites* was the same as that which exists between *Baculites* and some of the Ammonites (*Lytoceratidæ*); a relationship which led him to confer upon his new genus a name having the same signification as

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[1] Die Cephalopoden, p. 65.

[2] Prodr. de Paléont. Stratigr. vol. i. pp. 55, 114.

[3] *Ibid.* p. 58.

[4] Geogn. Beschreib. der Eifel, p. 40.

[5] Lethæa Rossica, vol. i. Seconde Section de l'ancienne Période, p. 1258.

[6] British Foss. Ceph. pt. i. p. 48.

[7] "Ueber die Anfangskammer von *Bactrites*," Zeitschr. der deutsch. geol. Gesell. vol. xxxvii. (i.) 1885, p. 3.

[8] The range of *Bactrites* appears to be as here stated, and it will be seen that the Silurian is left out, as there is no record of any species occurring therein. Barrande's species, *Bactrites Sandbergeri*, is the earliest known, and it is found in his Étage D, in the fossiliferous base of the Quartzites of that stage. Barrande states that it appears in the two extreme horizons of D, *i. e.* in *d* 1 [= Arenig (upper part), according to J. E. Marr] and *d* 5 [= Bala (upper part), according to the same authority], but that it fails to appear in the intermediate bands *d* 2, *d* 3, *d* 4.

[9] Die Versteinerungen des Rheinischen Schichtensystems in Nassau, 1850–1856, p. 124.

[10] Neues Jahrbuch für Mineralogie, &c. 1841, p. 240.

Baculites[1]. This analogy is again pointed out by the brothers Sandberger in the 'Verstein. Nassau' (p. 124), and Hyatt[2] also mentions it in terms of acquiescence; but he erroneously, as it appears, attributes the original suggestion made by G. Sandberger to Quenstedt.

In his "Genera of Fossil Cephalopods" Hyatt classes *Bactrites* under his group "Macrochoanites"[3], with the subheading "Transitiones," describing it, according to his knowledge of it at the time he wrote, as "a true Nautiloid, shedding the protoconch and presenting the cicatrix on the apex of the conch or true shell, as figured by Barrande (Syst. Sil. vol. ii. pl. ccccxc.), from drawings made by the author." "The ventral sutures," continues Hyatt, "are interrupted by the funnels [necks of the septa] as in Ammonoids, and the sutures are otherwise similar to those of *Mimoceras* and *Anarcestes* in some forms. These resemblances are precisely similar to those habitually occurring only between closely allied, parallel series in the two orders [Nautiloidea and Ammonoidea], which have been traced to a common radical. The inference is unavoidable, therefore, that we are here dealing with forms which have all sprung, at no very remote period, from an ancestor with a slender whorl and striæ of growth and sutures like those of the simpler and purely orthoceratitic forms of *Bactrites*."

The last-named forms which are thus included by Hyatt in the *Bactritidæ* are the following:—*Orthoceras pleurotomum*, Barrande (Syst. Sil. vol. ii. pl. ccxcvi.); *O. Xanthus*, Barr., *O. Endymion*, Barr., and *O. caduceus*, Barr. (pl. ccxcvii.); *O. fasciolatum*, Barr. (pl. cccxix.); *O. Pâris*, *O. eximium*, Barr. (pl. ccccxii.); *O. obliquiseptatum*, G. & F. Sandberger (Verstein. Nassau, pl. xviii.). The Silurian forms here mentioned (which include all the species except the last) "are evidently," says Hyatt, "the radicals of *Bactrites*, and we can only account for their affinities in form and in the transverse striæ and sutures with *Mimoceras* [*Goniatites*] *compressum*, by referring both to the common stock, and imagining them as the more direct descendants of that stock, which must have had banded shells similar to those of *Geisonoceras*"[4].

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[1] Amtlicher Bericht über die zwanzigste Versamml. der Gesell. deutsch. Naturforsch. und Aerzte zu Mainz, 1843, p. 157.

[2] "Genera of Fossil Cephalopods," Proc. Boston Soc. Nat. Hist. vol. xxii. 1884, p. 303.

[3] *Loc. cit.* See also p. 260 of the same memoir.

[4] "Genera of Fossil Cephalopods," p. 304. It may here be explained that *Geisonoceras* is a genus proposed by Hyatt (*loc. cit.* p. 275) to include the species of *Orthoceras* forming groups 10, 11, 12, 13, and 14 of Barrande (Syst. Sil. vol. ii. Texte iii. 1874).

Fig. 1.

a, lateral view of the young shell of *Nautilus pompilius*, showing the form of the apex; *b*, front view of the same specimen, showing the initial and some of the succeeding chambers with the siphuncle passing through them; *c*, extremity of a young specimen (natural size), showing the cicatrix or scar. (Reduced (except *c*) from Barrande's Syst. Sil. de la Bohême, vol. ii. pl. cccclxxxix. (x.) figs. 1, 4, 8.) *d*, apex, with *p*, remains of initial chamber or protoconch [1], of *Orthoceras elegans* (?), Münst. (Trias of St.

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[1] "The wrinkled lump ..... is unquestionably a part of the shell. It is not only closely attached, but the longitudinal striæ of the apex of the true conch are continuous upon the proximate parts of the lump. It had an aperture which must have remained open until the body of the veliger had entirely left the interior of the protoconch, and was then closed by the apical plate. There is a cicatrix upon the apex of the conch, which is invariably concealed by the lump when it [the lump] is present, and in some examples we observed the fracture of the outer layer of the shell on the apex of the conch and outside of the ordinary boundary of the cicatrix, which could only have been caused by

Cassian); *e*, apex of *Cyrtoceras* (*Meloceras*) *cornu*, de Kon., sp. (= *Orthoceras unguis*, Phil. pars), showing the cicatrix, *ci* (Carboniferous; Dublin). (Reduced from Hyatt's figures in his 'Genesis of the Arietidæ' (1889): *d* from p. 10, fig. 4; *e* from p. 11, fig. 14.) Both these figures were drawn by Professor Hyatt from specimens contained in the British Museum; *d* is one of the specimens numbered 36036, *e*, 30257. *f*, front view of initial chamber of *Cosmoceras ornatum*, Schlotheim, sp., *si*, siphuncle; *g*, lateral view of the same, *si*, siphuncle; *h*, upper view of the same (Callovian of Lautlingen, Württemberg). (Reduced from Branco's figures illustrating his memoir entitled "Beiträge zur Entwickelungsgeschichte der fossilen Cephalopoden" (Part i.), 'Palæontographica,' vol. xxvi. 1879–1880, pl. xii. fig. iv. *a*, *b*, *c*.) *i*, view of the initial and first chamber of *Belemnites Württembergicus*, Oppel; *si*, siphuncle (Upper Dogger of Ehningen). (Reduced from one of Branco's figures illustrating pt. ii. of the memoir quoted above, 'Palæontographica,' vol. xxvii. (i.) 1880, pl. viii. fig. v. *a*.) *k*, view of the initial and five succeeding chambers of *Bactrites Hyatti*?, Barrande; *si*, siphuncle. (From Branco's paper, "Ueber die Anfangskammer von *Bactrites*," Zeitschr. der deutsch. geol. Gesell. Band xxxvii. Heft i. p. 3, fig. 1.) *l*, view of the penultimate and third chamber of *Bactrites gracilis*, Sandberger (Devonian of Büdesheim); *m*, extremity of the same, showing the cicatrix. (Reduced from Branco's figures, 'Palæontographica,' vol. xxvii. (i.) 1880, pl. ix. fig. viii. *a*, *b*.) *n*, view of the initial and several succeeding chambers of *Goniatites compressus*, Beyrich (Devonian of Wissenbach). (Reduced from part of Branco's figure in the 'Palæontographica,' vol. xxvii. (i.) 1880, pl. ix. fig. ii. *a*.) *o*, view of the initial and part of two succeeding chambers of *Spirula Peronii*, Lamarck; *si*, siphuncle. (Reduced from part of Branco's figure in the 'Palæontographica,' vol. xxvii. (i.) 1880, pl. ix. fig. vii. *a*.)

In an important paper contributed to the 'Zeitschrift der deutschen geologischen Gesellschaft' (vol. xxxvii. (i.) p. i), Dr. Branco described and figured the initial chamber of a *Bactrites*. Branco begins his paper with a description of the initial chamber (Anfangskammer) of the Nautiloids, Ammonites, Goniatites, Belemnites, and Spirulids.

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the violent removal of the lump. The wrinkled and contracted aspect of the lump when preserved can be accounted for by assuming it to have been composed of conchiolin. This also accounts for its almost invariable absence, since such an organ must have been easily lost or destroyed. The lump must consequently be regarded as the remnants of conchiolinous protoconchs having elongated and narrow apertures; but probably they were, when in a living condition, much larger and more oval, and more similar to the protoconch of the Ammonoids. The continuity of the striæ from the conch to the protoconch also shows that the conch was built out from the aperture of the protoconch, layer after layer, and the concentric markings and the form of the apex, which correlates with that of the scar, sustain this idea." (Hyatt, 'Genesis of the Arietidæ' (1889), p. 9.)

He describes it as thimble-shaped in the Nautiloids (fig. 1, *a*, *b*), recumbent egg-shaped in the Ammonites (fig. 1, *f*, *g*, *h*) and almost all the Goniatites, while in the Belemnites and Spirulids, on the other hand, it is erect egg-shaped (fig. 1, *i*, *o*). Considering these strongly marked differences, says Branco, it is very remarkable that a Goniatite (*Goniatites compressus*, Beyrich, from the Wissenbach Slates—see fig. 1, *n*) should have been found with an initial chamber differing essentially from that of the rest of the Ammonites, but agreeing with that of the *Belemnites* and *Spirula*. Leaving out of consideration some other Goniatites (nearly related to *Goniatites compressus*) in which a similar feature was observed, this type of initial chamber, differing from that of the Ammonites, stood by itself, until the initial chamber of *Bactrites* was found in a specimen put into Branco's hands by Professor Beyrich. This differed widely in shape from the initial chamber of the Nautiloids, but agreed with that of *Goniatites compressus*. Branco describes it as "shaped like an egg standing upright, without scar, in the same way as is observed in *G. compressus*; and likewise, as in that species, the initial chamber (Anfangskammer) is separated from the rest of the shell-tube by a constriction. *Bactrites* belongs, therefore, to the group of *Asellati spiruliformes*." *Bactrites*, says Branco, is certainly not a Nautiloid, but is it a true Ammonite? This question, he adds, is not easily answered.

Upon the initial chambers of *Bactrites*, *Goniatites compressus*, and *G. fecundus*, Branco's group of *Asellati spiruliformes* is founded; it is so called because the first suture in these forms has no saddle, and the form of the chamber resembles that of *Spirula*. There are other Goniatites which equally possess an asellate first suture, but in these the form of the initial chamber in no way resembles that of *Spirula*, but forms a type of its own. Such species are classed by Branco under the name *Asellati ammonitiformes*[1]. On the other hand, all the other Goniatites, as well as the Ammonites, have the first suture-line furnished with a saddle, and they have, moreover, a differently formed initial chamber: these are the *Latisellati* and *Angustisellati*[2].

[1] Palæontographica, vol. xxvii. (i.) 1880, p. 68.

[2] It may here be mentioned that there are in Table-case 57, in the Cephalopoda Gallery, models by Dr. Branco of the initial chambers of the shells of the following Cephalopods:—*Nautilus pompilius*, *Orthoceras*, Goniatite of the group of Asellati, Ammonites of the groups of Latisellati and Angustisellati; also a model of the initial chamber and first whorl of *Goniatites compressus*, and the initial chambers of *Spirula Peronii* and of *Belemnites*.

To these groups of true Ammonites, continues Branco, *Bactrites* and *Goniatites compressus* certainly do not belong, and it is not to be expected that they should, if their geological sequence be taken into account, for *Bactrites* and *Goniatites compressus* are the earliest forms known to us in which the characters of the Ammonoid group originate[1]. It is true that in those ancient times both the *Asellati spiruliformes* and the *Asellati ammonitiformes* existed contemporaneously, and the question arises whether the first named of these groups is the most nearly related to *Spirula*. Dr. Branco has determined, after considering this question, that the *Asellati spiruliformes* occupy, with reference to their initial chamber, a position between the Ammonites and Spirulids, adding the Belemnites to the latter. But since the shell of the adult in the *Asellati spiruliformes* seems to be more nearly related to the Ammonites, through the other *Goniatites*, of the Nautilini group, it seems justifiable, he holds, to reckon the *Asellati spiruliformes* as a subdivision of the Ammonites.

I have here given a very full *résumé* of Dr. Branco's views because of their important bearing upon the question of the affinities of *Bactrites*. The same question has been again touched upon by Professor Hyatt in his 'Genesis of the Arietidæ,' a work already referred to. After referring to Branco's discovery, Hyatt observes that "it is quite possible that *Bactrites* of the Devonian may be a degraded form of *Mimoceras*, but in that case the latter is also a degraded form of *Anarcestes*, or transitional between it and *Bactrites*. To establish this proposition, forms of *Mimoceras* and *Anarcestes* should be produced in which uncoiling occurred in adults after a close-coiled stage of growth had been passed through. Such degraded forms are common in the Jura and Cretaceous, and enable the observer to connect *Baculites* with the normal coiled Ammonoids of the same formations. Whether this be so or not, the straight *Bactrites*-like young of some forms of *Anarcestes*, the gyroceran young of others of the Goniatitinæ, and the gyroceran adults and young of *Mimoceras*, indicate the derivation of the Goniatitinæ to have been from Silurian straight shells similar to *Bactrites*, if not directly from that genus itself.

The following authors have also recognized the affinities of *Bactrites* with the Ammonoidea. Thus, Pictet[2], Saemann[3], and

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[1] "Ueber die Anfangskammer von *Bactrites*," Zeitschr. der deutsch. geol. Gesell. vol. xxxvii. 1885, p. 8.

[2] Traité de Paléontologie, 2nd ed. 1854, vol. ii. p. 662.

[3] "Ueber die Nautiliden," Palæontographica. vol. iii. 1854, p. 130.

Keferstein [1], regard *Bactrites*, together with the Goniatites, as belonging to the group of the Ammonites. S. P. Woodward [2] brings Bactrites into near relationship with the Goniatites, placing it between the latter and *Ceratites*. Barrande [3] places *Bactrites* in the Family Goniatitidæ (composed of the three genera *Goniatites*, *Clymenia*, *Bactrites*), giving the latter an intermediate position between the Nautiloids and the Ammonoids, and considering *Bactrites* as a transitional form between the Goniatites and the Orthoceratites, particularly the group of Vaginati (=*Endoceras* [4]); but laying stress upon the nearer approach of *Bactrites* to the Orthoceratites than to the Goniatites.

Prof. James Hall [5], on the other hand, remarks that "The genus *Orthoceras*, as now constituted, admits of so great a range of variation in the form and characters of the siphuncle, as well as in the other elements of the shell, as to render the removal of the genus *Bactrites* to the *Goniatitidæ* undesirable. It seems to possess transitional features between the *Goniatitidæ* and *Orthoceratidæ*; and I prefer to arrange it, for the present at least, with the latter."

Bactrites carinatus, G. & F. Sandberger.

?1846. *Orthoceratites carinatus*, Keyserling, Wissenschaftliche Beobachtungen auf einer Reise in das Petschora-Land, im Jahre 1843, p. 271, pl. xiii. ff. 11, 11 *a*, 11 *b* [6]. (*Not* of Münster.)

1856. *Bactrites carinatus*, G. & F. Sandberger, Die Versteinerungen des Rheinischen Schichtensystems in Nassau, p. 129, pl. xvii. ff. 3, 3 *a–n*, 3*.

?1860. *Bactrites carinatus*, Eichwald, Lethæa Rossica ou Paléontologie de la Russie, vol. i., Seconde Section de l'ancienne Période, p. 1261.

1871. *Bactrites carinatus*, Kayser, "Studien aus dem Gebiete des rheinischen Devon," Zeitschr. der deutsch. geol. Gesell. vol. xxiii. p. 354.

1873. *Bactrites carinatus*, Kayser, ibid. vol. xxv. p. 635.

1876. *Bactrites carinatus*, Maurer, Neues Jahrbuch für Mineralogie, Geologie und Paläontologie, p. 827.

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[1] Classen und Ordnungen des Thierreiches, vol. iii. (ii.) 1862–1866, p. 1420.

[2] Manual of the Mollusca, 3rd ed., 1875, p. 197.

[3] Syst. Sil. de la Bohême, vol. ii. pt. i. 1867, pp. 47–48.

[4] See Part I. of the present Catalogue, 1888, p. 129.

[5] Palæontology of New York, vol. v. pt. ii. 1879, pp. 315, 316.

[6] Erroneously printed 12, 12 *a*, in the text; those numbers refer to an undetermined species figured upon the same plate.

1879. *Bactrites carinatus*, Gümbel, Geogn. Beschr. des Fichtelgebirges, p. 498.

1881. *Bactrites carinatus*, Koch, Jahrbuch der Königl. Preuss. geol. Landesanst. und Bergakad. zu Berlin, für das Jahr 1880, p. 241.

1884. *Bactrites carinatus*, Kayser, Jahrb. der Preuss. geol. Landesanst. und Bergakad. zu Berlin, für das Jahr 1883, pp. 17, 26.

1887. *Bactrites carinatus*, Tschernyschew, Mém. Com. Géol. (St. Petersburg), vol. iii. No. 3, p. 24.

[Not 1840. *Orthoceratites carinatus*, Münster, Beiträge zur Petrefactenkunde, iii. p. 100, pl. xix. ff. 8, *a*, *b*, *c*. 1849. *Melia Keyserlingii*, d'Orbigny, Prodrome de Paléontologie stratigraphique, vol. i. p. 56.]

Sp. Char. Shell very long and slender, the increase in diameter scarcely perceptible; sides compressed, making the transverse section elliptical. At one extremity of the ellipse a flattened keel commences and extends the whole length of the shell; at the other extremity the siphuncle is situated. Septa numerous, variable in their distance apart. Body-chamber very long. Dorsal lobe very obtuse. Dorsal saddle small, rounded. Lateral lobe very wide, deep, and rounded. Ventral saddle acutely angular. Casts (in pyrites) show faint marks of transverse, oblique ribbing.

Remarks. Keyserling's figures are so imperfect that they cannot be referred with certainty to the present species. Eichwald's reference to the latter is also somewhat doubtful. There need be no hesitation, however, about separating the present species from Münster's *Orthoceratites carinatus*[1], which differs from it in many essential characters; thus, Münster's species tapers more rapidly than Sandberger's, its siphuncle is central instead of being marginal, and although both possess a longitudinal, obtuse keel, this cannot be employed as a distinguishing character, because many other species have it; e. g. *Orthoceras serratulum*, Barrande, *O. placidum*, Barr.[2], and other allied forms, which have been classed by Hyatt in the genus *Bactrites*. (See *suprà*, p. 3.)

Prof. James Hall[3] has described a species (*Bactrites clavus*) from the Hamilton Group (Middle Devonian) of Scoharie, New York State, which, as he says, bears a very close resemblance to *B. carinatus*; but the American shell is larger and has wider septa than the German one.

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[1] See Part I. (1888) of the present Catalogue, pp. 12, 31.

[2] Syst. Sil. de la Bohême, vol. ii. 1868, pl. ccxcviii.

[3] Palæontology of New York, vol. v. pt. ii. 1879, p. 316, pl. lxxxiv. fig. 15, pl. cxiii. figs. 1–5.

It is a significant fact that the first species of *Bactrites* known, *B. Sandbergeri*, Barr.[1], is by far the largest. Those of the Devonian and Carboniferous, on the other hand, are comparatively small, some of the Devonian species extremely so. Barrande's largest example measured 60 mm. in length, with 9 chambers, the greatest diameter being 27 mm.

Horizon and Locality. Orthoceratiten-Schiefer (Lower Devonian). Hartz: Lerbach (C. 3462).

Bactrites Büdesheimensis, Ferd. Roemer.

1856. *Bactrites gracilis* (pars), G. & F. Sandberger, Die Versteinerungen des Rheinischen Schichtensystems in Nassau, p. 130, pl. xvii. ff. 5, *b–e* (excl. ff. 5, 5 *a*, 5*).

1876. *Bactrites Budesheimensis*, Ferd. Roemer, Lethæa Geognostica, Theil i., Lethæa Palæozoica, Atlas, pl. xxxv. ff. 14, *a–c*[2].

1880. *Bactrites gracilis*, Gosselet, Esquisse Géologique du Nord de la France et des Contrées voisines, fasc. i. pl. iv. f. 15.

Sp. Char. Shell slender, elongated, very slowly tapering; section nearly circular. Body-chamber very long. Septa approximate, distant from each other about one-third of the diameter of the shell (cast). Sutures oblique, slightly undulating; ventral lobe funnel-shaped, dorsal and lateral lobes imperceptible. Test unknown. Casts smooth and polished.

Remarks. This species differs from *B. gracilis* in its slower rate of increase and much closer septa.

Horizon and Localities. Goniatiten-Schiefer (Upper Devonian). Devonshire: Saltern Cove, near Torquay[3] (C. 1787 and C. 1825 *a*, presented by J. E. Lee, Esq., F.S.A., F.G.S.). Eifel: Büdesheim (3464, *a–g*).

Bactrites Ausavensis[4], Steininger, sp.

1853. *Orthoceratites Ausavensis*, Steininger, Geognostische Beschreibung der Eifel, p. 40, pl. i. f. 11.

1885. *Bactrites Ausavensis*, Waldschmidt, Zeitschr. der deutsch. geol. Gesell. vol. xxxvii. (iv.) p. 921, pl. xxxix. ff. 4, 4 *a*, 4 *b*.

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[1] Syst. Sil. de la Bohême, vol. ii. 1867, p. 49, pl. ccxlv. ff. 9–21.

[2] The text descriptive of the Mollusca figured in this Atlas has not been published.

[3] Only one specimen from this locality (No. C. 1825 *a*) can be identified as a *Bactrites*; probably the others belong to the same genus, but in them the siphuncle cannot be seen.

[4] Ausava is the ancient Roman name of the village of Oos near Büdesheim.

Sp. Char. Shell slender, tapering rather rapidly, *i. e.* at the rate of about 1 in 6. Section subelliptical. Septa very numerous, from three to four being contained in the space of a line. Sutures slightly undulating; ventral lobe funnel-shaped. Body-chamber and test unknown.

Remarks. This species is distinguished from *Bactrites gracilis*, G. Sandberger[1], by its more conical form, *i. e.* slower rate of tapering, and more numerous septa. "In a length of half an inch nineteen septa may be counted in *Bactrites Ausavensis*; in *B. gracilis* only seven" (*Steininger*).

Horizon and Locality. Goniatiten-Schiefer (Upper Devonian). Eifel: Büdesheim (47676 *a*).

Bactrites obliquiseptatus ?, G. & F. Sandberger, sp.

1856. *Orthoceras obliquiseptatum*, G. & F. Sandberger, Die Versteinerungen des Rheinischen Schichtensystems in Nassau, p. 160, pl. xviii. ff. 2, 2 *a–e*.

1884. *Bactrites obliquiseptatus*, Hyatt, "Genera of Fossil Cephalopods," Proceed. Boston Soc. Nat. Hist. vol. xxii. p. 304.

Sp. Char. Shell moderately elongated, slowly tapering. Transverse section circular. Test unknown. Cast smooth, polished. Septa very numerous, about three in the space of a line. Sutures oblique, undulating; ventral lobe funnel-shaped. Siphuncle marginal.

Remarks. A small fragment of the septate part of the shell is identified with this species, on account of its strongly oblique septa and circular section. In the figures of this species given by G. & F. Sandberger the sutures (side view, 2, 2 *c*) are represented as perfectly straight lines stretching obliquely across the shell; they should have been slightly curved.

Horizon and Locality. Goniatiten-Schiefer (Upper Devonian). Eifel: Büdesheim (C. 3463).

Bactrites? Steinhaueri, J. Sowerby, sp.

1814. *Orthocera Steinhaueri*, J. Sowerby, Min. Conch. vol. i. p. 132, pl. lx. f. 4.

1828. *Orthoceras Steinhaueri*, Fleming, History of British Animals, p. 239.

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[1] Amtlicher Bericht über die zwanzigste Versammlung der Gesell. deu sch, Naturforsch. und Aerzte zu Mainz, 1843, p. 157.

1832. *Orthocera Steinhaueri*, Dumont, Mémoire sur la Constitution géologique de la Province de Liège, p. 356.

? 1836. *Orthoceras Steinhaueri*, Phillips, Geology of Yorkshire, pt. ii. p. 238, pl. xxi. f. 5[1].

1841. *Orthoceras Steinhaueri*, Helmersen, Bull. scient. de l'Acad. Impér. des Sciences de Saint-Pétersbourg, vol. viii. p. 174.

1844. *Orthoceras Steinhaueri*, M'Coy, Synop. Carboniferous Fossils of Ireland, p. 8.

1849. *Melia Steinhaueri*, d'Orbigny, Prodr. de Paléont. Stratigr. vol. i. p. 114.

1852. *Orthoceras Steinhaueri*, Giebel, Fauna der Vorwelt, vol. iii. (i.) p. 252.

1854. *Orthoceras Steinhaueri*, Morris, Cat. British Fossils, 2nd ed. p. 311.

? 1854. *Bactrites Steinhaueri*, F. A. Roemer, "Beiträge zur Kenntn. des nordwestl. Harzgebirges," Palæontographica, vol. iii. p. 93, pl. xiii. ff. 26, *a*, *b*.

Sp. Char. "Shell transversely striated, very gradually tapering; chambers very deep; septa distant, even-edged, circular; siphuncle close to one side." (*Sowerby.*)

Remarks. It is with some hesitation that I place this species in the genus *Bactrites*, for though the siphuncle is close to the margin in the type specimen, the characteristic funnel-shaped lobe in the sutures is not observable. Phillips describes his specimen also as having the "siphuncle marginal;" it presents also similar ornaments to Sowerby's specimen, so that there can be little doubt of their identity, albeit the septa are somewhat closer in Phillips's than they are in Sowerby's fossil. A portion of the body-chamber is preserved in Phillips's specimen (cast), but there are no marks upon it. A small fragment of the test adheres to it.

Horizon and Locality. Carboniferous Limestone. Yorkshire: near Halifax (43841, Sowerby's type, in "Sowerby Collection;" C. 185, Phillips's type, "Gilbertson Collection").

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[1] Phillips gives two localities—Bolland and Halifax, Yorkshire—in his description of this species; but he omits to mention from which of these places the specimen figured by him was obtained.

Suborder *AMMONOIDEA* [1].

Shell conical, involute (most forms), or partly involute and partly evolute (*Scaphites*, &c.); sometimes bent on itself at one or both ends (*Ptychoceras*, *Diptychoceras*), or hook-like (*Hamites*), or even turreted (*Turrilites*, &c.), or essentially straight (*Baculites*). Aperture simple, or with variously formed lateral and ventral expansions. Suture-line undulating, serrated, or with more or less numerous digitate branches. Siphuncle marginal, without internal deposits. Initial chamber spherical or ovoid. Aptychus or Anaptychus often present.

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[1] Dr. Emil Haug has called in question the suitability of the terms Retrosiphonata and Prosiphonata proposed by Dr. Paul Fischer (1882–3) for his division Tetrabranchiata [Nautiloidea], and adopted by Dr. von Zittel (1884), as divisions of the Nautiloidea and Ammonoidea, on the ground that the Ammonites are retrosiphonate in the young, and that in the case of *Tirolites rectangularis* the prosiphonate stage is not attained until the shell has reached a tolerably advanced age, a little before the last chamber. Again, in the genera *Glyphioceras* and *Pericyclus* the necks of the septa (*goulots*) are directed forwards and backwards at the same time. According to Holzapfel, continues Haug, *Pericyclus Kochi*, a true Goniatite, would be even more prosiphonate than retrosiphonate. The manner in which the necks are directed indicates the period in which the evolution of an Ammonite occurs; but it does not furnish a character of sufficient importance for the establishment of two great subdivisions. The Ammonites might be divided, according to the form of the aperture, into two great groups, of which one would compose the forms with a ventral sinus, the other those with a ventral lappet (*languette*). But this classification would separate forms closely allied in all their other features. Branco's three divisions, *Asellati*, *Latisellati*, and *Angustisellati*, ought likewise to be regarded as representing rather the stages in the evolution of the Ammonites than as natural divisions. According to Holzapfel the suborders *Leiostraca* and *Trachyostraca*, founded by Mojsisovics upon the character of the ornamentation, are equally untenable, because there are insensible gradations between the perfectly smooth forms and those distinctly ornamented, and, on the other hand, certain species which are smooth when young become ornamented (*Trachyostraca*) in the adult, and *vice versa*. Haug concludes by remarking that it is preferable to dispense with any great divisions in the Ammonoidea, and to separate them for the present into families and genera only. (See Ann. Géol. Univ. 1889, vol. vi. 1890.)

In accordance with this view the terms Retrosiphonata and Prosiphonata are not employed in this Catalogue, but in recognition of the important character of the sutures, the Ammonoidea are divided into two groups, viz., Group A, to include the Clymenias and Goniatites, with more or less simple sutures; Group B, to include the Ammonites, with highly complex sutures.

Group A.

Ammonoidea with more or less simple suture-line.

Family CLYMENIDÆ[1].

Genus **CLYMENIA,** Münster[2], emend. Gümbel[3].

(*Planulites* (Parkinson), Münster, 1832[4]; *Endosiphonites,* Ansted, 1838[5]; *Aganides* (Montfort), pars, Pictet, 1845[6]; *Trocholites,* pars, d'Orbigny, 1849[7] (*not* of Conrad); *Nautilus,* Giebel, 1852[8]; ***Nautilus*** (subgenus of), Blake, 1882[9].)

Gen. Char. Shell more or less flattened, planorbiform, with numerous (from $3\frac{1}{2}$ to $6\frac{1}{2}$) whorls. Transverse section higher than wide, sometimes oval, sometimes subquadrangular in shape. Siphuncle close to the dorsal (inner) side of the whorls. Necks of the septa directed backwards, sometimes short, sometimes elongate funnel-shaped, and invaginated (see fig. 2). Body-chamber long, generally occupying $\frac{3}{4}$ of the last whorl. Aperture with a ventral sinus. Septa numerous, sutures forming a simple, wavy or angular lateral lobe; in rare cases there is more than one such lobe. A dorsal (internal) lobe is present, below the siphuncle. On the periphery there is a saddle which is sometimes divided by a median lobe. Initial chamber elliptical, the first septum curved forwards; the centre never perforated. Surface ornamentation usually consisting only of fine transverse lines which form a backwardly directed sinus on the periphery.

This genus is exclusively Upper Devonian.

Remarks. The genus *Clymenia* was included by Münster, M'Coy,

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[1] This family was constituted by Edwards (Mon. Eocene Mollusca and Univalves of England, vol. i. 1849 (Mon. Pal. Soc.), p. 50) for the reception of *Clymenia* and *Aturia*; but the latter has been removed from the family, which now consists solely of the genus *Clymenia.*

[2] Beiträge zur Petrefactenkunde, (i.) 1839, p. 6 (*fide* Gümbel).

[3] "Ueber Clymenien in den Uebergangsgebilden des Fichtelgebirges," Palæontographica, vol. xi. (iii.) 1863, p. 118.

[4] Ueber Goniatiten und Planuliten im Uebergangskalke des Fichtelgebirges, p. 4.

[5] Trans. Cambridge Phil. Soc. vol. vi. pt. iii. p. 416.

[6] Traité Élémentaire de Paléontologie, vol. ii. p. 339.

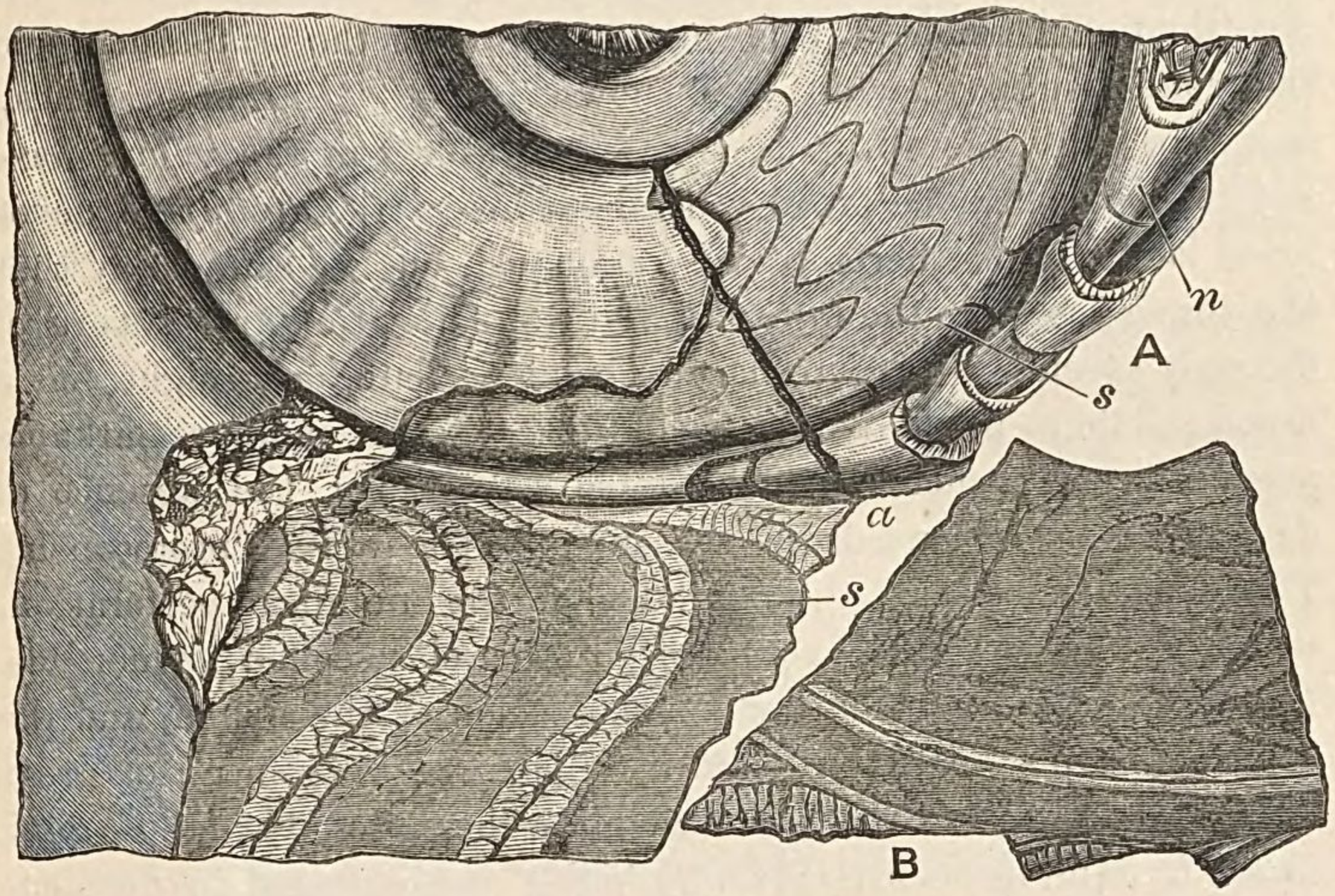
[7] Prodr. de Paléont. stratigr. vol. i. p. 56.

[8] Fauna der Vorwelt, vol. iii. (i.) p. 126.

[9] British Fossil Cephalopoda, pt. i. p. 62.

S. P. Woodward, and indeed by most authors in the *Nautilidæ*. Quenstedt[1] (and, more recently, Blake) considered it, however, as merely a subgenus of *Nautilus*, while Edwards, on the other hand, erected it into a Family (*Clymenidæ*) consisting of the two genera *Clymenia* and *Aturia*, the latter being thus associated with the former on account of its having a similar siphuncle. D. T. Ansted

Fig. 2.



Clymenia speciosa.—A, fragment of a large specimen, consisting of parts of three whorls, showing (*n*) the invaginated necks of the septa, which contain the siphuncle; *s*, *s*, sutures. B, back of part of the same specimen (polished to show the size of the siphuncle), broken off along the line *a*. Copied from Gümbel's figures, Palæontographica, vol. xi. (iii.) 1863, pl. xx. ff. 3*a*, 3*b*[2].

proposed the name *Endosiphonites*, in lieu of *Clymenia*, on the ground that the latter name had already been appropriated by Cuvier for a genus of Tubicolar Annelids, and the name *Clymene* (not *Clymenia*) is still so employed. The termination of the two names, however, serves to distinguish them, and Ansted's proposed designation has not found acceptance.

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[1] De Notis Nautilearum primariis.

[2] The original specimen is contained in the Palæontological Museum (Alte Akademie), Munich. Through the courtesy of Dr. von Zittel I was enabled during my visit to Munich in 1889 to inspect this specimen, as well as others belonging to the Gümbel collection.

Reverting to the question of the systematic position of *Clymenia*, we have the high authority of Dr. Branco for placing it among the Ammonoidea. This author observes: "*Clymenia* belongs to the *Ammonitidæ*. The first suture not, however, being known to me with sufficient certainty, I have left *Clymenia* out of the Table altogether" [1].

Remarking upon the phylogenetic relations of *Clymenia*, Hyatt [2] says:—"This group has characteristics which are so evenly balanced that we should have found it difficult to decide whether it was Nautiloid or Ammonoid, if it had not been for the protoconch, and the young sutures, which are shown in the 'Palæontographica,' vol. xvii. 1880, pl. viii. ff. 1, *a–g*. The sutures in the young have ventral lobes, and the broad ventral saddles of the group are developed later. It is therefore an Ammonoid, but we cannot say that the young resemble the lower Goniatites, since the first suture of the only species known, in place of being asellate, or straight, has a broad saddle as in the higher Goniatites. A still more remarkable peculiarity, if general, is, as stated by Branco, the absence of depressions on either side of the neck of the ovisac [protoconch]. These [depressions] are the remnants of the umbilical perforation, which are present in the young of all other close-coiled Ammonoids. These characteristics, and the dorsal position of the siphon, and the presence of deep annular [dorsal] lobes, are differences of great importance and show that we must place the series above the *Nautilinidæ* [3]. The forms are evidently highly concentrated in development, but descendants probably of the same stock as *Anarcestes*.... The group appears to have had a very narrow distribution chronologically and geographically, and was probably a highly specialized series with exceptionally rapid evolution in some open fields [? seas] of the Devonian."

Clymenia may be readily distinguished from *Goniatites* by the character of the sutures, the constantly dorsal position of the siphuncle, and, further, by the form of the initial chamber. So close, however, is the relationship between the two that Sandberger,

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[1] The "Table" here referred to is a "Tentative Classification of Cephalopods on the basis of the form of the initial chamber, and of the first suture." "Beiträge zur Entwickelungsgeschichte der fossilen Cephalopoden," Part ii. Palæontographica, vol. xxvii. (i.) 1880, p. 67, footnote 3.

[2] "Genera of Fossil Cephalopods," Proceed. Boston Soc. Nat. Hist. vol. xxii. 1884, p. 312.

[3] A group of Goniatites proposed by Hyatt under that name and nearly equal to Nautilini of Beyrich.

Gümbel, and Barrande included them in the same Family (*Goniatitidæ*).

The derivation of the genus *Clymenia* is at present enigmatical. Mojsisovics [1] and Hoernes [2] consider the *Clymeniæ* to be the radical forms of the *Ammonea Trachyostraca*. Mojsisovics draws attention to the striking resemblance between the following species of *Clymenia*, viz.:—*Clymenia spinosa*, Münst., *Clym. striata*, Münst., *Clym. binodosa*, Münst., *Clym. speciosa* (Münst.), Gümbel, *Clym. semicostata*, Münst., *Clym. subarmata*, Münst., *Clym. flexuosa*, Münst., *Clym. annulata*, Münst. (in Gümbel's "Clymenien des Fichtelgebirges," Palæontographica, vol. xi.), *Clym. arietina*, G. Sandb. (Verhandl. des naturh. Ver. f. Rheinl. u. Westph. 1853, pl. vii. f. 5), &c., and his Triassic genera *Dinarites* and *Tirolites* (see Med. Triasprov. pls. i. to iii.).

Clymenia has been divided in various ways by different authors. Münster [3], the founder of the genus, distinguished two divisions, based upon the form of the sutures:—(1) Forms with rounded lateral lobes; (2) Forms with angular lateral lobes. Gümbel [4] split up the genus into groups, as follows:—

1. *Euclymeniæ*: peripheral saddle without lobe; necks of the septa short, not forming a continuous tube.
2. *Nothoclymeniæ*: necks of the septa long, invaginated.
?3. *Cycloclymeniæ*: siphuncle unknown, peripheral lobe present. Whorls rounded, nearly cylindrical, very slightly embracing.

Groups 1 and 2 have each three minor groups, which are again divided into two or three groups, so that it happens that several of the groups have only one representative species! It may be mentioned that group ?3 was formed for the reception of a single species (*Clymenia planorbiformis*).

Hyatt [5] erects *Clymenia* into a suborder (*Clymeninæ* [6]), and making use of some of Gümbel's divisions designates three families,

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[1] Die Cephalopoden der Mediterranen Triasprovinz, 1882, p. 3.

[2] Elemente der Paläontologie (Palæozool.), 1884, pp. 315–316.

[3] Ueber die Planuliten [*Clymeniæ*] und Goniatiten, 1832, pp. 5, 8.

[4] "Ueber Clymenien des Fichtelgebirges," Palæontographica, vol. xi. 1863, p. 118.

[5] "Genera of Fossil Cephalopods," Proceed. Boston Soc. Nat. Hist. vol. xxii. 1884, p. 312.

[6] The selection of the termination *inæ* for a suborder is unfortunate, and may cause confusion, because it has long been reserved as the mark of a subfamily.

viz. *Cyrtoclymenidæ*, *Cymaclymenidæ*, *Gonioclymenidæ*. These he subdivides into nine genera, as follows:—(*Cyrtoclymenidæ*), *Cyrtoclymenia*, *Oxyclymenia*, *Platyclymenia*; (*Cymaclymenidæ*), *Cymaclymenia*, *Sellaclymenia*; (*Gonioclymenidæ*), *Cryptoclymenia*, *Cycloclymenia*, *Gonioclymenia*, *Discoclymenia*.

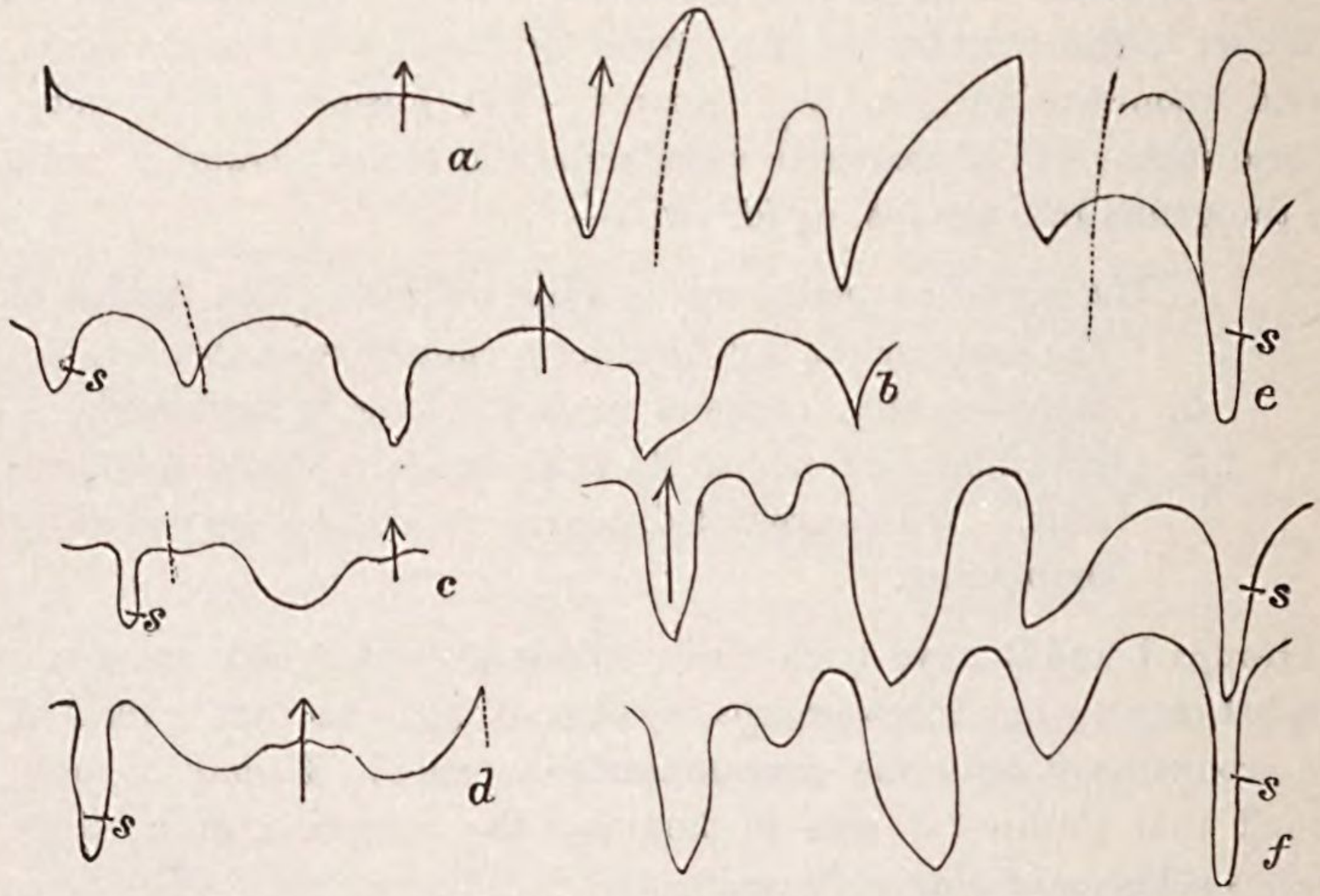
Clymenia is found in the so-called "Clymenien-Kalk" of the Fichtelgebirgs (Elbersreuth, Gattendorf); in Silesia (Ebersdorf), in Westphalia, Thuringia, France, Belgium, England, and North America [1].

a. *Euclymeniæ*.

[Species with small tubular siphuncle.]

Clymenia angustiseptata ?, Münster.

Fig. 3.



Diagrams of the suture-line of the following species of *Clymenia*:—*a*, *C. angustiseptata*; *b*, *C. striata*; *c*, *C. binodosa*; *d*, *C. lævigata*; *e*, *C. speciosa*; *f*, *C. subarmata*. The arrows point in the direction of the aperture of the shell and indicate the peripheral saddle; *s* marks the position of the siphuncle, which in *Clymenia* is on the inner curvature of the shell, or anti-peripheral.

1832. *Planulites angustiseptatus*, Münster, Ueber die Planuliten und Goniatiten im Uebergangskalke des Fichtelgebirges, p. 7, pl. i. ff. 3, *a–c*.

?1832. *Planulites inflatus*, Münster, ibid. p. 7, pl. i. ff. 5, *a*, *b*.

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[1] See Amer. Journ. Sci., Jan. 18 2, vol. xliii. p. 57; also Geol. Mag., April 1892, vol. ix. p. 173.

1832. *Goniatites latus*, Münster, ibid. p. 17.
? 1832. *Goniatites subnodosus*, Münster, ibid. p. 32.
1837. *Ammonites latus*, Beyrich, Beiträge zur Kenntn. der Versteinerungen des Rheinischen Uebergangsgebirges, i. pp. 29, 43.
? 1841. *Clymenia sagittalis*, Phillips, Palæozoic Fossils of Cornwall, Devon, and West Somerset (Mem. Geol. Surv. England and Wales), p. 125, pl. liv. ff. 243, *a–c*.
? 1841. *Clymenia fasciata*, Phillips, ibid. p. 125, pl. liii. ff. 242, *a–d*.
1841. *Clymenia plurisepta*, Phillips, ibid. p. 126, pl. liv. ff. 244, *a–c*.
? 1842. *Clymenia brevicostata*, Münster, Beiträge zur Petrefactenkunde, (v.) p. 124, pl. xii. ff. 5, *a*, *b*.
1843. *Clymenia angustiseptata*, Münster, ibid. (i.) 2nd ed. pp. 4, 36, pl. i. *a*. ff. 3, *a–c*.
1843. *Clymenia cincta*, Münster, ibid. p. 37, pl. xvi. ff. 5, *a–c*.
1843. *Clymenia plicata*, Münster, ibid. p. 36, pl. xvi. ff. 4, *a–c*.
1843. *Clymenia inflata*, Münster, ibid. p. 4, pl. i. *a*. ff. 5, *a*, *b*.
1843. *Clymenia lata*, Münster, ibid. p. 36.
1843. *Clymenia subnodosa*, Münster, ibid. p. 36, pl. vi. *a*. f. 7.
1843. *Goniatites subnodosus*, Münster, ibid. p. 25.
1848. *Clymenia campanulata* (? *plicata*, Münster), Richter, Beitrag i. zur Paläontologie des Thüringer-Waldes, p. 29, pl. iii. ff. 67–72.
1849. *Trocholites angustiseptata*, d'Orbigny, Prodr. de Paléont. stratigr. vol. i. p. 56.
1849. *Trocholites cincta*, d'Orbigny, ibid. p. 56.
1852. *Nautilus angustiseptatus*, Giebel, Fauna der Vorwelt, vol. iii. (i.) p. 127.
? 1853. *Clymenia arietina*, G. Sandberger, Verhandl. des naturhistorischen Vereines der preussischen Rheinlande und Westphalens, p. 182, pl. vii. ff. 5, 5 *a*, 5 *b*.
1856. *Clymenia angusteseptata*, Richter, Beitrag ii. zur Paläontologie des Thüringer-Waldes, Denkschr. der Kaiserl. Akad. der Wissensch. Wien, vol. xi. (i.) p. 112.
1863. *Clymenia angustiseptata*, Gümbel, Ueber Clymenien in den Uebergangsgebilden des Fichtelgebirges, Palæontographica, vol. xi. p. 120, pl. xv. ff. 1–6.
1870. *Clymenia angustiseptata*, Tietze, Ueber die devonischen Schichten von Ebersdorf, Palæontographica, vol. xix. (iii.) p. 133.
1873. *Clymenia angustiseptata*, Kayser, Studien aus dem Gebiete des rheinischen Devon, Zeitschrift der Deutsch. geol. Gesell. vol. xxv. p. 633, pl. xx. ff. 2, *a–c*.
1879. *Clymenia angustiseptata*, Gümbel, Die organischen Ueberreste der Oberdevonstufe, Geogn. Beschreib. des Fichtelgebirges, p. 499.

Sp. Char. Shell involute, with few (4–5) whorls, nearly half the inner whorls covered by the succeeding ones; increasing rapidly. Transverse section elliptical, usually higher than wide, but in some examples this condition is reversed (*Clymenia cincta*, Münster). Umbilicus deep, nearly one third the diameter of the shell. Septa

very numerous, about 45 to a whorl. Sutures simple, curving slightly backwards on the sides of the shell, without angularity (see fig. 3, *a*, p. 18). Siphuncle large. Surface of the test ornamented with fine thread-like, sickle-shaped lines, whose convexity is directed forwards. These lines form a backwardly directed sinus on the periphery. In the young there are, at intervals, faint rib-like elevations, curved like the fine lines just described. The cast beneath the thick test shows only a trace of these elevations, and on the outer whorls they disappear altogether.

Remarks. Gümbel[1] has included under the name *angustiseptata* several of Münster's species, besides the typical form. Though the examples thus united under one name were badly preserved, yet this circumstance did not, in Gümbel's opinion, render their affinities doubtful. Gümbel included in the synonymy of the present species some of Richter's and Phillips's species. A fine specimen ascribed to *Clymenia plurisepta*, Phillips, is the only representative of the present species in the Collection. It has fewer septa than are typically present in Münster's species, as interpreted by Gümbel, but in other respects it agrees with that form, and I can find no other place for it.

Horizon and Locality. Upper Devonian. Cornwall: South Petherwin (37827).

Clymenia binodosa, Münster.

1832. *Goniatites binodosus*, Münster, Ueber die Planuliten und Goniatiten im Uebergangskalke des Fichtelgebirges, p. 31, pl. vi. ff. 5, *a*, *b*.
1843. *Goniatites binodosus*, Münster, Beiträge zur Petrefactenkunde, (i.) 2nd ed. p. 24, pl. vi. ff. 5, *a*, *b*.
1843. *Clymenia binodosa*, Münster, ibid. p. 37, pl. ii. ff. 3, *a–c*.
1849. *Clymenia binodosa*, d'Orbigny, Prodr. de Paléont. stratigr. vol. i. p. 57.
1852. *Clymenia Münsteri*, M'Coy, British Palæozoic Fossils, fasc. ii. p. 402, pl. ii. A. ff. 12, 12 *a*, 12 *b*.
1852. *Nautilus binodosus*, Giebel, Fauna der Vorwelt, vol. iii. (i.) p. 129.
1853. *Clymenia binodosa*, G. Sandberger, Verhandl. des naturhistorischen Vereines der preussischen Rheinlande und Westphalens, zehnter Jahrgang, p. 180, pl. viii. ff. 5, 5 *a*, 5 *b*.
1854. *Clymenia Münsteri*, Morris, Cat. British Fossils, 2nd ed. p. 301.
1863. *Clymenia binodosa*, Gümbel, Ueber Clymenien in den Uebergangsgebilden des Fichtelgebirges, Palæontographica, vol. xi. p. 134, pl. xix. ff. 1, *a–e*.

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[1] "Ueber Clymenien," Palæontographica, vol. xi. 1863, p. 120.

1870. *Clymenia binodosa*, Tietze, Ueber die devonischen Schichten von Ebersdorf, Palæontographica, vol. xix. (iii.) p. 134, Taf. xvi. ff. 10, 10 *a*, 11.
1879. *Clymenia binodosa*, Gümbel, Die organischen Ueberreste der Oberdevonstufe, Geogn. Beschreib. des Fichtelgebirges, p. 499.
1889. *Clymenia binodosa*, Bergeron, Géologie du Rouergue et de la Montagne Noire, Annales des Sciences géologiques, vol. xxii. p. 146.

Sp. Char. Shell evolute, all the inner whorls exposed; slowly increasing, with numerous (6–8) slightly embracing whorls; section subquadrate, higher than wide. Sides flat, periphery narrow, about half the width of the sides. Umbilicus wide, with subangular margins. Septa rather remote, their distance from each other being equal to about half the width of the sides. Sutures with a wide ventral (peripheral) saddle, which has inconspicuous backwardly directed median lobe; the sides with a broad and deep lateral lobe; the dorsal (siphonal) lobe very narrow and a little deeper than the lateral lobe (see fig. 3, *c*, p. 18). Siphuncle very large, the necks of the septa ending somewhere about halfway between the septa. The ornaments of the test consist of prominent, rather distant transverse ribs (17 or 18 to a whorl), which do not begin to be developed until the third or fourth whorl is attained, or if present earlier they are very obscure. The ribs form prominent nodes on the edge of the periphery, and are slightly thickened again at the margin of the umbilicus.

Remarks. The present species resembles *Clymenia speciosa*, Münst., in general habit, but in the latter the ribs are strongest in the earlier whorls, and become fainter in the later ones, finally almost entirely disappearing. The sutures of the two species are also very different, the lobes in *C. speciosa* being sharply angular, while those of *C. binodosa* are rounded. Gümbel remarks that there can be no doubt about the identity of M'Coy's *Clymenia Münsteri* with the present species. He further observes that *C. binodosa* bears a general resemblance to *C. spinosa*, Münst., but the ornaments as well as the suture-line serve to distinguish them.

Horizon and Locality. Clymenien-Kalke (Upper Devonian). Bavaria: Schübelhammer (81832, 81851 *a*, *b*).

Clymenia lævigata, Münster.

1832. *Planulites lævigatus*, Münster, Ueber die Planuliten und Goniatiten im Uebergangskalke des Fichtelgebirges, p. 5, pl. i. ff. 1–*f*.
1840. *Clymenia lævigata*, von Buch, Ueber Goniatiten und Clymenien

in Schlesien, Physik. Abhandl. der Königl. Akad. der Wissensch. zu Berlin aus dem Jahre 1838, p. 161.

1840. *Clymenia* (*Endosiphonites*, Ansted) *lævigata*, J. de C. Sowerby, in Sedgwick and Murchison, On the Physical Structure and Older Stratified Deposits of Devonshire, Trans. Geol. Soc. vol. v. pt. iii. p. 703, and Explanation of the Plates &c. pl. liv. f. 19.

1841. *Clymenia lævigata*, Phillips, Palæozoic Fossils of Cornwall, Devon, and West Somerset (Mem. Geol. Surv. England & Wales), p. 124, pl. lii. ff. 239, *a–c*.

1843. *Clymenia lævigata*, Münster, Beiträge zur Petrefactenkunde, (i.) 2nd ed. pp. 3, 35, pl. i. *a*. ff. 1, *a–f*.

1848. *Lituites ellipticus*, Richter, Beitrag i. Paläontologie des Thüringer-Waldes, p. 28, pl. iii. f. 65.

1849. *Trocholites lævigata*, d'Orbigny, Prodr. de Paléont. stratigr. vol. i. p. 56.

1849. *Clymenia lævigata*, Quenstedt, Die Cephalopoden, p. 69, pl. iii. ff. 2, *a–c*.

1850. *Clymenia lævigata*, F. von Hauer, Ueber die Gliederung der geschichteten Gebirgsbildungen in den Alpen und den Karpathen, Sitzungsb. der mathematisch-naturwiss. Classe der Kaiserl. Akad. der Wissensch. Wien, Part i. (iii.) p. 277.

1852. *Nautilus lævigatus*, Giebel, Fauna der Vorwelt, vol. iii. (i.) p. 126 (pars).

1853. *Clymenia lævigata*, Geinitz, Die Versteinerungen der Grauwackenformation in Sachsen, ii. p. 36, Taf. ix. ff. 1 *a*, *b*, 2, 3.

1853. *Clymenia lævigata*, G. Sandberger, Verhandl. des naturhistorischen Vereines der preussischen Rheinlande und Westphalens, zehnter Jahrgang, p. 184, pl. vii. ff. 1, 1, *a–e*.

1853. *Clymenia lævigata*, G. Sandberger, Ueber Clymenien, Neues Jahrbuch für Min. &c. p. 519, pl. vii. ff. 7, 8.

1854 *Clymenia lævigata*, Morris, Cat. British Fossils, 2nd ed. p. 301.

1863. *Clymenia lævigata*, Gümbel, Ueber Clymenien in den Uebergangsgebilden des Fichtelgebirges, Palæontographica, vol. xi. p. 137, pl. xvi. ff. 5–8.

1870. *Clymenia lævigata*, Tietze, Ueber die devonischen Schichten von Ebersdorf, Palæontographica, vol. xix. (iii.) p. 133.

1873. *Clymenia lævigata*, Kayser, Studien aus dem Gebiete des rheinischen Devon, Zeitschr. der deutsch. geol. Gesell. vol. xxv. p. 631.

1879. *Clymenia lævigata*, Gümbel, Die organischen Ueberreste der Oberdevonstufe, Geogn. Beschreib. des Fichtelgebirges, p. 499.

1889. *Clymenia lævigata*, Bergeron, Géologie du Rouergue et de la Montagne Noire, Annales des Sciences géologiques, vol. xxii. p. 146, pl. vii. ff. 3, 3 *a*.

1889. *Clymenia lævigata*, E. Kayser, Ueber das Devon in Devonshire und im Boulonnais, Neues Jahrbuch, vol. i. p. 185.

Sp. Char. Shell very evolute, planorbiform, all the inner whorls

exposed; very slowly increasing, with numerous (7–9) whorls; section oval, higher than wide. Sides rounded, periphery narrow, rounded. Umbilicus very wide, shallow, with rounded margins. A deep constriction is seen on the cast, close to the margin of the aperture. Septa remote, 14 to 16 to a whorl; sutures simple, with rounded lateral lobe, and a wide, flat, ventral saddle (see fig. 3, *d*, p. 18). Siphuncle close to the narrow, hollowed-out dorsal side. Test smooth, or with very fine lines of growth, which form a backwardly directed sinus upon the periphery. Slight elevations are sometimes seen upon the cast.

Remarks. Dr. Gümbel observes that the five varieties of *C. lævigata* (*elliptica*, *semicingulata*, *semiplicata*, *nana*, and *speciosa*) erected by Münster are of no importance. He, however, recognizes as a variety a remarkable form communicated to him by Prof. Braun of Beyreuth under the name *cingulata*, Braun, so named from the strong folds (5–6) upon the whorls. Dr. Gümbel has done a signal service to palæontology in ridding it of such species as those described under new names by Richter, from crushed and distorted examples. These species now swell the list of synonyms of some of the well-known species of *Clymenia*.

The present species is easily distinguished from *C. undulata* (the most nearly related form) by its perfectly smooth shell and more broadly rounded periphery, while the highly characteristic, sharp-pointed lateral lobe of *C. undulata*, when it can be seen, affords a ready means of separating the two species.

C. lævigata is the most abundant species in the Clymenien-Kalke.

Horizon and Localities. Clymenien-Kalke (Upper Devonian). Bavaria: Schübelhammer (62795, 81823 *a–c*, 81869, C. 1786), Elbersreuth (75144 *a*, *b*), Köstenberg (47663 *a*, *b*); exact locality in Bavaria unknown (81829, C. 3503–4).

Clymenia undulata, Münster.

1832. *Ammonites inæquistriatus*, von Buch, Ueber Goniatiten, Physikal. Abhandl. der Königl. Akad. der Wissensch. zu Berlin aus dem Jahre 1830, p. 178, pl. ii. ff. 10, 11.

1832. *Planulites undulatus*, Münster, Ueber die Planuliten und Goniatiten im Uebergangskalke des Fichtelgebirges, p. 9, pl. ii. ff. 2, *a–c*.

1832. *Planulites pygmæus* [1], Münster, ibid. p. 6, pl. i. ff. 2, *a–d*.

1832. *Planulites inæquistriatus*, Münster, ibid. p. 10, pl. i. ff. 4, *a–c*.

1832. *Planulites linearis*, Münster, ibid. p. 11, pl. ii. ff. 5, *a-c*.

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[1] This is only the young of *C. undulata* (fide Gümbel).

1832. *Planulites serpentinus*, Münster, ibid. p. 12, pl. iii. ff. 1, *a–c.*
1838. *Endosiphonites carinatus*, Ansted, Trans. Cambridge Phil. Soc. vol. vi. pt. iii. p. 419, pl. viii. f. 2.
1838. *Endosiphonites minutus*, Ansted, ibid. p. 420, pl. viii. f. 3.
1840. *Clymenia undulata*, von Buch, Ueber Goniatiten und Clymenien in Schlesien, Physikal. Abhandl. der Königl. Akad. der Wissensch. aus dem Jahre 1838, p. 160.
1840. *Clymenia linearis*, J. de C. Sowerby, in Sedgwick and Murchison, On the Physical Structure and Older Stratified Deposits of Devonshire, Trans. Geol. Soc. vol. v. pt. iii. p. 703, and Explanation of the Plates &c. pl. liv. f. 19 *a.*
1840. *Clymenia Sedgwicki*, Münster, Beiträge zur Petrefactenkunde, (iii.) p. 92, pl. xvi. ff. 3, *a–c.*
1840. *Clymenia bisulcata*, Münster, ibid. p. 93, pl. xvi. ff. 6, *a*, *b.*
1841. *Clymenia linearis*, Phillips, Palæozoic Fossils of Cornwall, Devon, and West Somerset (Geol. Surv. England and Wales), p. 125, pl. liii. ff. 241, *a*, *b.*
1842. *Clymenia sublævis*, Münster, Beiträge zur Petrefactenkunde, (v.) p. 124.
1843. *Clymenia undulata*, Münster, ibid. (i.) p. 5, pl. ii. *a.* ff. 2, *a–c*, 6, *a–c.*
1843. *Clymenia pygmæa*, Münster, ibid. p. 3, pl. i. *a.* ff. 2, *a–d.*
1843. *Clymenia sublævis*, Münster, ibid. pl. ii. *a.* ff. 3, *a*, *b.*
1843. *Clymenia inæquistriata*, Münster, ibid. p. 6, pl. ii. *a.* ff. 4, *a–c.*
1843. *Clymenia linearis*, Münster, ibid. p. 7, pl. ii. *a.* ff. 5, *a–c.*
1843. *Clymenia serpentina*, Münster, ibid. p. 8, pl. iii. *a.* ff. 1, *a–c.*
1843. *Clymenia tenuistriata*, Münster, ibid. p. 39.
1843. *Clymenia Otto* [1], Münster, ibid. p. 55, pl. ii. ff. 9, *a–c.*
1848. *Clymenia planorbiformis*, Richter, Beitrag i. zur Paläontologie des Thüringer-Waldes, p. 30, pl. iii. ff. 86–88. (*Not* of Münster.)
1848. *Clymenia cristata*, Richter, ibid. p. 31, pl. iii. ff. 89–93.
1849. *Clymenia undulata*, d'Orbigny, Prodr. de Paléont. Stratigr. vol. i. p. 57.
1852. *Nautilus inæquistriatus*, Giebel, Fauna der Vorwelt, vol. iii. (i.) p. 130.
1852. *Clymenia undulata*, M'Coy, British Palæozoic Fossils, fasc. ii. p. 404.
1853. *Clymenia undulata*, Geinitz, Die Versteinerungen der Grauwackenformation in Sachsen, ii. p. 37, pl. ix. ff. 7, *a–c.*
1853. *Clymenia undulata*, G. Sandberger, Verhandl. des naturhistorischen Vereines der preussischen Rheinlande und Westphalens, zehnter Jahrgang, p. 189, pl. viii. ff. 1, 1 *a*, 1 *b.*
1853. *Clymenia undulata*, G. Sandberger, Ueber Clymenien, Neues Jahrbuch für Min. &c. p. 519, pl. vii. ff. 5, 6.
1853. *Clymenia bisulcata*, Geinitz, Die Versteinerungen der Grauwackenformation in Sachsen, ii. p. 38, pl. ix. ff. 8, *a–c.*

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[1] ? *Ottonis* (fide Gümbel).

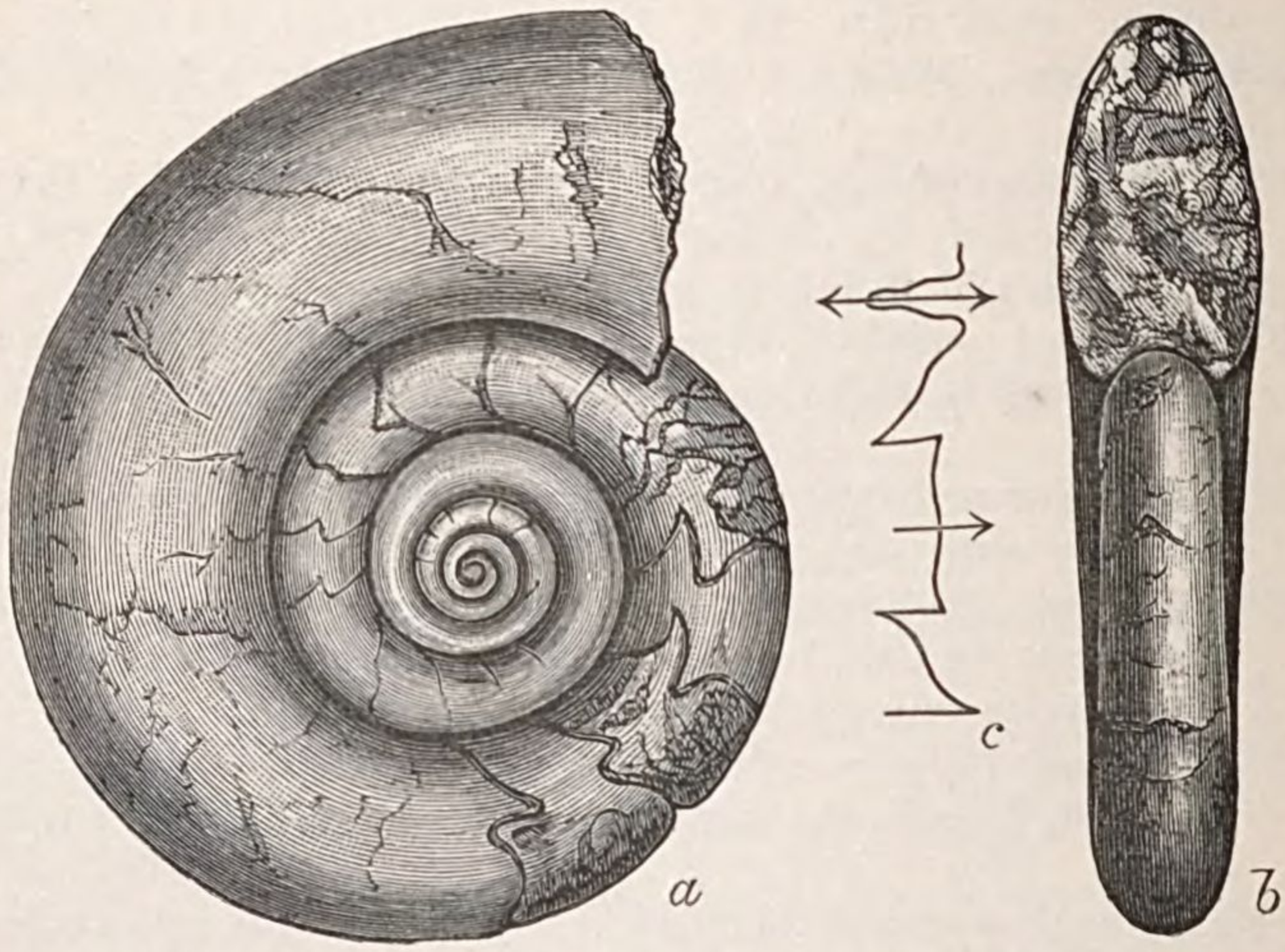
1853. *Clymenia planorbiformis*, Geinitz, ibid. p. 37, pl. ix. ff. 6, *a–c*.
1854. *Clymenia undulata*, Morris, Cat. British Fossils, 2nd ed. p. 302.
1855. *Clymenia linearis*, Hébert, Bull. Soc. géol. France, sér. 2, vol. xii. p. 1179.
1856. *Clymenia bisulcata*, Richter, Beitrag ii. zur Paläontologie des Thüringer-Waldes, Denkschr. der Kaiserl. Akad. der Wissensch. Wien, vol. xi. (i.) p. 112.
1859. *Clymenia undulata*, F. Roemer, Neues Jahrbuch für Min. &c. p. 604.
1863. *Clymenia undulata*, Gümbel, Ueber Clymenien in den Uebergangsgebilden des Fichtelgebirges, Palæontographica, vol. xi. p. 140, pl. xvii. ff. 1–9, pl. xviii. ff. 12, *a–e*.
1870. *Clymenia undulata*, Tietze, Ueber die devonischen Schichten von Ebersdorf, Palæontographica, vol. xix. (iii.) p. 133, Taf. xvi. f. 9.
1879. *Clymenia undulata*, Gümbel, Die organischen Ueberreste der Oberdevonstufe, Geogn. Beschreib. des Fichtelgebirges, p. 499.
1887. *Clymenia* (*Oxyclymenia*) *undulata*, Frech, Die Paläozoischen Bildungen von Cabrières (Languedoc), Zeitschr. der deutsch. geol. Gesell. vol. xxxix. pp. 372, 448, 486.
1887. *Clymenia* (*Oxyclymenia*) *undulata*, Frech, Ueber das Devon der Ostalpen, Zeitschr. der deutsch. geol. Gesell. vol. xxxix. pp. 699, 718.
1889. *Clymenia undulata*, Bergeron, Géologie du Rouergue et de la Montagne Noire, Annales des Sciences géologiques, vol. xxii. p. 146.

Sp. Char. Shell evolute, planorbiform, slowly increasing, with numerous (6–9) very slightly embracing whorls. Umbilicus very large, shallow, exposing all the inner whorls. Transverse section higher than wide. Sides somewhat flattened, periphery narrow, rarely subcarinate. The adult shell is sometimes slightly furrowed in the middle of the sides. The septa are somewhat remote from each other (12 to 20 in a complete whorl); the sutures on the sides of the shell are bent into two sharp angles—one directed forwards, the other backwards; they form an undivided saddle upon the periphery. Siphuncle close to the dorsal (inner) side, slender. The surface of the test is thickly covered with fine, unequal, doubly sickle-shaped lines, with their convex sides directed forwards. These lines make a backwardly directed sinus upon the periphery. The wrinkle-layer ("Runzelschicht") may frequently be observed on the periphery, elevated upon a kind of keel.

Remarks. There is not space here to give the reasons (very fully set forth) which led Dr. Gümbel to include so many species in the synonymy of *C. undulata*. The bulk of them, as may be seen above, are Münster's names, and any one comparing his figures

(' Beiträge,' Heft i. &c.) with those of Gümbel (" Ueber Clymenien," Palæont. xi. pl. xvii.) will probably find that Münster had little warrant for the erection of his species.

Fig. 4



Clymenia undulata.—*a*, lateral view, showing some of the sutures; *b*, front view, slightly restored; *c*, diagram of a suture-line, copied from Gümbel's figure, 'Palæontographica,' vol. xi. (iii.) 1863, pl. xvii. f. 1 *c*. Figures *a* and *b* are drawn from a specimen in the British Museum obtained by Mr. J. E. Lee from Dr. Ferdinand Roemer of Breslau, and subsequently presented by Mr. Lee to the Museum.

M'Coy appears to have been the first to combine several of Münster's species under *C. undulata*, the following having been included by him in the synonymy of that species:—*C. sublævis*, *C. inequistriata*, *C. sublinearis*, *C. linearis* ('British Palæozoic Fossils,' M'Coy, 1852, fasc. ii. p. 404).

The distinctive characters separating the present species from *C. lævigata* have been enumerated under the description of the latter.

Horizon and Localities. Clymenien-Kalke (Upper Devonian). Bavaria: Schübelhammer (63755, 75141, 81824–7, 81828 *a*, *b*, 81830 *a*, *b*, 81849 *a*, 81850, 81852, C. 1785 *a*–*e*); Köstenberg (47664 *a*, *b*, 47665 *a*, *b*); Elbersreuth (75144 *c*, 81854); Geuser (81855). Silesia: Ebersdorf (39736–7, 39739–43, C. 1491, C. 1955). Cornwall: South Petherwin (32955).

Clymenia striata, Münster.

1832. *Ammonites semistriatus*, von Buch, Ueber Goniatiten, Physikal. Abhandl. der Königl. Akad. der Wissensch. zu Berlin aus dem Jahre 1830, p. 179, pl. ii. f. 12.

1832. *Planulites striatus*, Münster, Ueber die Planuliten und Goniatiten im Uebergangskalke des Fichtelgebirges, p. 13, pl. iii. ff. 2, *a–c*, 3, *a–c*, 4, 5.

1832. *Planulites striatus*, var. *costellatus*, Münster, ibid. p. 13, pl. iii. ff. 2, *a–c*.

1832. *Planulites striatus*, var. *semistriatus*, Münster, ibid. p. 14, pl. iii. f. 4.

1832. *Planulites striatus*, var. *planus*, Münster, ibid. p. 14, pl. iii. f. 5.

1832. *Planulites striatus*, var. *umbilicatus*, Münster, ibid. p. 14.

1832. *Planulites compressus*, Münster, ibid. pp. 7, 15, pl. i. ff. 4, *a–c*.

1840. *Clymenia striata*, von Buch, Ueber Goniatiten und Clymenien in Schlesien, Physikal. Abhandl. der Königl. Akad. der Wissensch. aus dem Jahre 1838, p. 161.

1840. *Clymenia dorsocostata*, Münster, Beiträge zur Petrefactenkunde, (iii.) p. 93, pl. xvi. ff. 5 *a*, *b*.

1841. *Clymenia striata*, Phillips, Palæozoic Fossils of Cornwall, Devon, and West Somerset (Geol. Surv. England and Wales), p. 125, pl. liii, ff. 240 *a*, *b*.

1843. *Clymenia striata*, Münster, Beiträge zur Petrefactenkunde, (i.) p. 9, pl. iii. *a*. ff. 2, *a–c*, 3, *a–c*, 4, 5.

1843. *Clymenia compressa*, Münster, ibid. p. 4, pl. i. *a*. ff. 4, *a–c*.

1843. *Clymenia ornata*, Münster, ibid. p. 127, pl. ii. ff. 7, *a–c*.

1848. *Clymenia striata*, Richter, Beitrag i. zur Paläontologie des Thüringer-Waldes, p. 31, pl. iv. ff. 94–99.

? 1848. *Clymenia campanulata*, Richter (pars), ibid. p. 29, pl. iii. ff. 67, 68.

1849. *Clymenia striata*, d'Orbigny, Prodr. de Paléont. stratigr. vol. i. p. 57.

1852. *Clymenia quadrifera*, M'Coy, British Palæozoic Fossils, fasc. ii. p. 403, pl. ii. A. ff. 13, 13 *a*, 13 *b*.

1852. *Nautilus flexuosus*, Giebel, Fauna der Vorwelt, vol. iii. (i.) p. 132.

1853. *Clymenia striata*, G. Sandberger, Verhandl. des naturhistorischen Vereines der preussischen Rheinlande und Westphalens, zehnter Jahrgang, p. 191, pl. viii. ff. 2, 2 *a*, 2 *b*.

1853. *Clymenia striata*, G. Sandberger, Neues Jahrbuch für Min. &c. p. 520, pl. vii. ff. 9, 10.

1855. *Clymenia striata*, F. A. Roemer, Beiträge zur geol. Kenntn. des nordwestl. Harzgebirges, iii. p. 150, pl. xxii. ff. 15 *a–c*.

? 1856. *Clymenia plicata*, Richter, Beitrag ii. zur Paläontologie des Thüringer-Waldes, Denkschr. der Kaiserl. Akad. der Wissensch. Wien, vol. xi. (i.) p. 112.

1863. *Clymenia striata*, Gümbel, Ueber Clymenien in den Uebergangsgebilden des Fichtelgebirges, Palæontographica, vol. xi. p. 144, pl. xviii. ff. 1–10.
1870. *Clymenia striata*, Tietze, Ueber die devonischen Schichten von Ebersdorf, Palæontographica, vol. xix. (iii.) p. 133.
1873. *Clymenia striata*, Kayser, Studien aus dem Gebiete des rheinischen Devon, Zeitschr. der deutsch. geol. Gesell. vol. xxv. p. 631.
1877. *Clymenia striata*, C. Reid, Geol. Mag. [2] vol. iv. p. 455.
1879. *Clymenia striata*, Gümbel, Die organischen Ueberreste der Oberdevonstufe, Geogn. Beschreib. des Fichtelgebirges, p. 499.
1887. *Clymenia* (*Oxyclymenia*) *striata*, Frech, Die Paläozoischen Bildungen von Cabrières (Languedoc), Zeitschr. der deutsch. geol. Gesell. vol. xxxix. pp. 372, 448, 486.
1887. *Clymenia* (*Oxyclymenia*) *striata*, Frech, Ueber das Devon der Ostalpen, Zeitschr. der deutsch. geol. Gesell. vol. xxxix. pp. 699, 718.

Sp. Char. Shell rather involute, but exposing all the inner volutions, rapidly increasing, having less numerous (4–5) whorls than *C. undulata*; in the inner whorls about half, in the outer about two-thirds of the whorl is covered by the preceding one. Section oval, with a deep dorsal emargination; higher than wide. Umbilicus narrow, step-shaped, rather deep. Sides flattened; peripheral surface with rounded edges; sometimes narrowed into a blunt keel. Septa tolerably close together (16–20 in a whorl); the sutures with a sharply angular and sinuous lateral lobe, the peripheral saddle broad, a little raised in the centre, with rounded edges (see fig. 3, *b*, p. 18). Siphuncle rather large. Surface of the shell ornamented with fine, transverse, wavy, thread-like lines, which form a backwardly-directed sinus upon the periphery; numerous undulating flat ribs or folds (var. *ornata*, Münst.) are also present, but they tend to become obsolete in the peripheral region.

Remarks. This very distinct species is most nearly related to *C. undulata*, but it is clearly distinguished from that species by its much more embracing whorls, and by the peculiar form of the lateral lobe of the sutures.

Most of the species bearing Münster's names in the list of references at the head of the description of the present species were united together by Münster himself as varieties of *C. striata*. They are thus merged into one species by Gümbel, in his exhaustive memoir on the *Clymeniæ* of the Fichtelgebirg, above quoted.

Horizon and Localities. Clymenien-Kalke (Upper Devonian). Bavaria: Schübelhammer (75142–3, 81824 *a*, *b*, 81831 *a*, *b*, 81853

a–c), Geuser (81856); exact locality in Bavaria unknown (81847). Silesia: Ebersdorf (39738). Cornwall: South Petherwin (32956; transferred from the Museum of Practical Geology). Locality unknown (C. 1737; presented by J. E. Lee, Esq., F.S.A., F.G.S.).

b. *Nothoclymeniæ.*

[Species with large siphuncle, enclosed in the invaginated necks of the septa.]

Clymenia speciosa, Münster, sp.

1832. *Ammonites speciosus*, von Buch, Ueber Goniatiten, Physikal. Abhandl. der Königl. Akad. der Wissensch. zu Berlin aus dem Jahre 1830, p. 180, pl. ii. f. 7.
1832. *Goniatites speciosus*, Münster, Ueber die Planuliten und Goniatiten im Uebergangskalke des Fichtelgebirges, p. 27, pl. vi. ff. 1, *a–c*.
1832. *Goniatites spurius*, Münster, ibid. p. 30.
1840. *Goniatites biimpressus*, von Buch, Ueber Goniatiten und Clymenien in Schlesien, Physikal. Abhandl. der Königl. Akad. der Wissensch. aus dem Jahre 1838, p. 153, ff. ii. 1–3.
? 1842. *Clymenia acuticosta* (Braun), Münster, Beiträge zur Petrefactenkunde, v. p. 126, pl. xii. ff. 6, *a–c*.
1843. *Goniatites speciosus*, Münster, ibid. i. p. 21, pl. vi. ff. 1, *a–c*.
1843. *Goniatites clymeniæformis*, Münster, ibid. p. 49, pl. xvii. f. 4.
1843. *Goniatites Preslii*, Münster, ibid. p. 49, pl. xvii. ff. 3, *a–c*.
1843. *Goniatites Cottai*, Münster, ibid. p. 50.
1843. *Goniatites subcarinatus*, Münster, ibid. p. 50, pl. xviii. ff. 1, *a–c*.
1843. *Goniatites canalifer*, Münster, ibid. p. 51, pl. xviii. f. 2 (suture-line).
1843. *Goniatites Roemeri*, Münster, ibid. p. 52, pl. xviii. f. 3 (suture-line).
1843. *Goniatites arquatus*, Münster, ibid. p. 52, pl. xviii. f. 4 (suture-line).
1843. *Goniatites Bucklandii*, Münster, ibid. p. 52, pl. xviii. f. 5 (suture-line).
? 1848. *Goniatites speciosus*, Richter, Beitrag i. zur Paläontologie des Thüringer-Waldes, p. 42, pl. vi. f. 204.
1848. *Goniatites Bucklandi*, Richter, ibid. p. 34, pl. iv. ff. 116–119.
1849. *Aganides speciosus*, d'Orbigny, Prodr. de Paléont. Stratigr. vol. i. p. 60.
1852. *Clymenia speciosa*, Giebel, Fauna der Vorwelt, vol. iii. (i.) p. 127.
1863. *Clymenia speciosa*, Gümbel, Ueber Clymenien in den Uebergangsbilden des Fichtelgebirges, Palæontographica, vol. xi. p. 150, pl. xix. ff. 6–8, pl. xx. ff. 1–4.

1870. *Clymenia speciosa*, Tietze, Ueber die devonischen Schichten von Ebersdorf, Palæontographica, vol. xix. (iii.) p. 134.
1879. *Clymenia speciosa*, Gümbel, Die organischen Ueberreste der Oberdevonstufe, Geogn. Beschreib. des Fichtelgebirges, p. 499.
1887. *Clymenia* (*Gonioclymenia*) *speciosa*, Frech, Die Paläozoischen Bildungen von Cabrières (Languedoc), Zeitschr. der deutsch. geol. Gesell. vol. xxxix. pp. 372, 448, 486.
1887. *Clymenia* (*Gonioclymenia*) *speciosa*, Frech, Ueber das Devon der Ostalpen, Zeitschr. der deutsch. geol. Gesell. vol. xxxix. pp. 699, 718.

Sp. Char. Shell evolute, slowly increasing, with numerous, flattened, very slightly embracing whorls. Umbilicus very wide and shallow, exposing all the evolutions. Transverse section subquadrangular, much higher than wide. Periphery narrow, hollowed out, sometimes provided with a median keel-like elevation (*Goniatites subcarinata*, *G. canalifer*, Münst.), or this may be absent. Septa very numerous (24–30 to a whorl); sutures with a deep, narrow, peripheral lobe, and two prominent lateral saddles, of which the first appears to be more or less deeply lobed upon the peripheral margin (see fig. 3, *e*, p. 18). Siphuncle large, resting in a tube formed by the invaginated necks of the septa (see fig. 2, p. 15). Surface of the shell in the outer whorls of older examples with low, slightly bent, folds or ribs, which are somewhat nodose at the edge of the periphery. The inner whorls are ornamented with distinct, prominent ribs (*Goniatites Cottai*, Münst.), which are spinulose at the margin of the umbilicus. Fine lines of growth cover the ribs and the spaces between them.

Remarks. This species, which is characterized by a great variety of forms, resembles *Clymenia binodosa* and *C. angulosa*, Münst., in its flat, disk-like shape. The present species is distinguished from the former by its sutures, by its much more numerous, flatter ribs, which continue to the innermost whorls, the latter being almost smooth in *C. binodosa*. *C. angulosa* is readily separated from the present species by the absence of ribs.

Horizon and Localities. Clymenien-Kalke (Upper Devonian). Bavaria: Schübelhammer (81839 *a–c*, 81857 *a*, *b*, 81861); Heinersreuth (C. 362).

Clymenia subarmata, Münster.

1832. *Goniatites subarmatus*, Münster, Ueber die Planuliten und Goniatiten im Uebersgangskalke des Fichtelgebirges, p. 28, pl. vii. ff. 2, *a–c*.

1840. *Goniatites vinctum*, J. de C. Sowerby, Trans. Geol. Soc. vol. v. ser. iii. Explanation of Plates, pl. liv. f. 18.

1841. *Goniatites insignis*, Phillips, Palæozoic Fossils of Cornwall, Devon, and West Somerset, p. 119, pl. xlix. ff. 228, *a*, *b*.

1842. *Clymenia subarmata*, Münster, Beiträge zur Petrefactenkunde, (v.) p. 123, pl. xii. f. 4.

1843. *Goniatites subarmatus*, Münster, ibid. (i.) p. 22, pl. vi. *a*. ff. 2, *a–c*.

1852. *Aganides vinctus*, M'Coy, British Palæozoic Fossils, fasc. ii. p. 401.

1856. *Clymenia subarmata*, Richter, Beitrag ii. zur Paläontologie des Thüringer-Waldes, Denkschr. der Kaiserl. Akad. der Wissensch. Wien, vol. xi. (i.) p. 112, pl. i. ff. 22, 23.

1863. *Clymenia subarmata*, Gümbel, Ueber Clymenien in den Uebergangsgebilden des Fichtelgebirges, Palæontographica, vol. xi. p. 155, pl. xxi. ff. 1, 2.

1870. *Clymenia subarmata*, Tietze, Ueber die devonischen Schichten von Ebersdorf, Palæontographica, vol. xix. (iii.) p. 133.

1873. *Clymenia subarmata*, Kayser, Studien aus dem Gebiete des rheinischen Devon, Zeitschr. der deutsch. geol. Gesell. vol. xxv. p. 629, pl. xx. ff. 3, *a–c*.

1879. *Clymenia subarmata*, Gümbel, Die organischen Ueberreste der Oberdevonstufe, Geogn. Beschreib. des Fichtelgebirges, p. 499.

Sp. Char. Shell evolute, exposing all the volutions, slowly increasing, with numerous (6–7) whorls. Sides flattened, periphery rather broadly rounded. Section subquadrangular, higher than wide. Umbilicus very wide, shallow, with subangular margins. Septa somewhat numerous (about 24 to a whorl); the sutures with a deep, narrow, peripheral lobe, and two prominent lateral saddles, of which the first is divided by a shallow lobe (see fig. 3, *f*, p. 18). Siphuncle large. The surface of the test on the outer whorls of the older individuals is ornamented with indistinct, irregular, rounded ribs or nodose elevations. In the younger whorls (about 2 inches diameter) the ribs are much stronger and sharper, tending to form nodes near the edge of the umbilicus. In still earlier whorls the ribs are less and less distinct, while the nodes are more strongly developed (about 12 to a whorl). The whole surface is covered with fine curved lines of growth.

Remarks. The present species is very nearly related to *Clymenia speciosa*, Münst.; but it is readily distinguished by its more rounded sides and periphery, and also by the nodose character of its ribbing.

Phillips's *Goniatites insignis*, which he himself compares with *Clymenia binodosa*, Münster, belongs undoubtedly (to judge by the description and figures) to the present species.

Horizon and Locality. Clymenien-Kalke (Upper Devonian). Bavaria: Schübelhammer (81834).

DOUBTFUL SPECIES.

Clymenia paradoxa, Münster.

1843. *Clymenia paradoxa*, Münster, Beiträge zur Petrefactenkunde, i. p. 41, pl. xvi. ff. 6, *a–d*.

1870. *Clymenia paradoxa*, Tietze, Ueber die devonischen Schichten von Ebersdorf, Palæontographica, vol. xix. (iii.) p. 136, pl. xvi. f. 14.

1879. *Clymenia paradoxa*, Gümbel, Geogn. Beschreib. des Königreichs Bayern, iii. 'Geogn. Beschreib. des Fichtelgebirges,' p. 499.

Sp. Char. Shell flattened, discoid, triangular; whorls slowly increasing, very numerous, rounded, ornamented with numerous prominent transverse ribs.

Remarks. The evidence for regarding this species as a *Clymenia*, or even as a Cephalopod, seems to be wholly wanting, and it is inserted here merely to draw attention to the references to it in the literature of the group. I think, however, that its connection with the Cephalopoda might well be severed. No septa have ever been observed in this strange form, and it is treated as "problematical" by Gümbel, as well as by Münster.

Clymenia (?) *solarioides*, v. Buch [1], is closely allied to the present species, but it also is not known to be septate.

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[1] "Ueber Goniatiten und Clymenien in Schlesien," Physikal. Abhandl. der Königl. Akad. der Wissensch. zu Berlin aus dem Jahre 1838 (1840), p. 157, fig. 5.

The following five familes (*Nautilinidæ*, *Primordialidæ*, *Magnosellaridæ*, *Glyphioceratidæ*, *Prolecanitidæ*) include the old group of the Goniatites; they differ from the *Clymenidæ* especially in having the siphuncle invariably situated close to the outer margin of the shell, as in the Ammonites.

Family NAUTILINIDÆ.

(*Nautilini*, Beyrich.)

Suture-line very simple, peripheral lobe undivided. Siphonal necks long, directed backwards.

Genus **MIMOCERAS**, A. Hyatt [1].

Type. *Ammonites compressus*, H. E. Beyrich, De Goniatitis in montibus rhenanis occurrentibus, 1837, p. 5, pl. i. f. 6.

Gen. Char. Shell discoidal, widely umbilicated; whorls not in contact in the earlier stages of growth, but becoming contiguous at a later period. Sutures very simple, concave upon the sides of the shell, with a funnel-shaped peripheral lobe. Initial chamber oviform (fig. 1, *n*, p. 4), antero-posteriorly elongate.

Devonian.

Remarks. Prof. Hyatt describes *Mimoceras* as including "two well-known species of true Goniatites [*G. compressus* and *G. ambigena*],.... separable from *Bactrites* in no essential characteristic, except the presence of a permanent protoconch upon the apex. The septa have simple concave sutures, and dorsal [inner] saddles without annular lobes; the whorls have no impressed zone, and the shells are therefore not truly nautilian in form, but gyroceran, and even the compressed whorls are similar to those of some [species of] *Bactrites*. The ventral lobe is a simple funnel lobe, as in *Bactrites*, and it divides the ventral saddles in the same way. Their characteristics and the protoconch ally them, however, even more closely with *Anarcestes*, and oblige us to place them in the *Nautilinidæ*. This evidence appears to need but one more link—the finding of a *Bactrites* with a globular protoconch" [2].

The simple suture-lines of *Mimoceras* and the two allied groups, *Anarcestes* and *Agoniatites*, clearly differentiate them from the other

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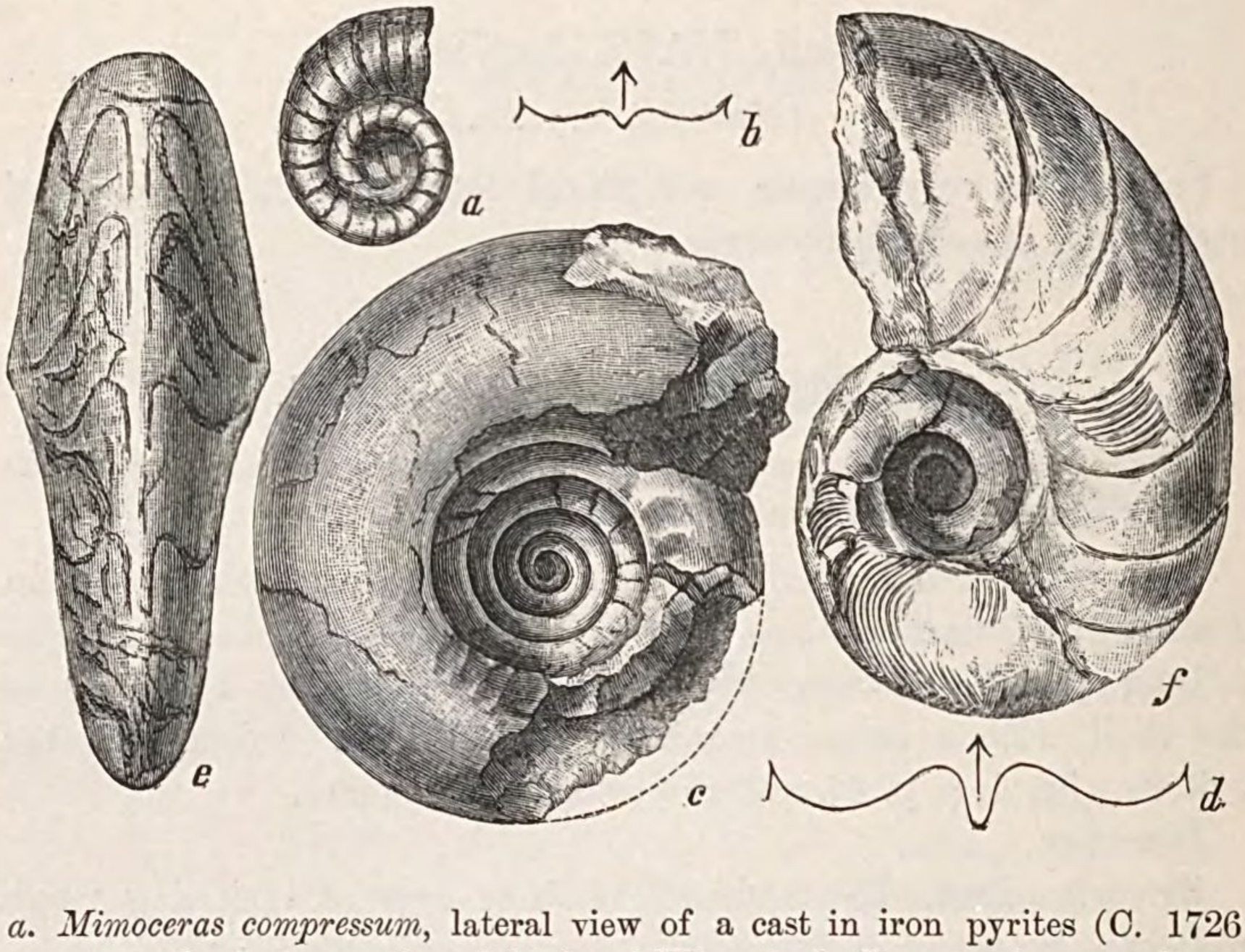
[1] Proc. Boston Soc. Nat. Hist. vol. xxii. (1884) p. 309.

[2] The discovery has been made by Branco. [See Zeitschr. deutsch. geol. Gesell. ("Ueber die Anfangskammer von *Bactrites*"), 1885, Band xxxvii. Heft i. p. 1.]

groups of the Goniatites, in which the sutures are, comparatively speaking, complex. The close affinities of *Bactrites* and *Mimoceras* have already been dwelt upon under the description of the former (*suprà*, p. 2). It may be added that Hyatt considers that "the

Fig. 5.



a. *Mimoceras compressum*, lateral view of a cast in iron pyrites (C. 1726) from the Orthoceratiten-Schiefer of Wissenbach, Nassau; *b*, suture-line of the same species. *c*. *Anarcestes lateseptatus*?, lateral view of a cast in iron pyrites (C. 1728), from the same locality and formation as *a*. *d*. *Anarcestes Noeggerati*, suture-line. *e*. *Agoniatites Bohemicus*, peripheral view of a cast (70976 *a*) showing the peripheral lobes of the suture-lines; *f*, lateral view of the same specimen. From the Devonian beds (Étage G) of Hluboč̌ep, Bohemia. *a*, *c*, *e*, *f* are drawn from specimens in the British Museum; *b*, *d* are copied from G. and F. Sandberger (Verstein. rhein. Schichtensyst. Nassau, 1850–56, pl. xi. ff. 4 *d*, 1 *f*). *a* and *c* are drawn of the natural size; *e* and *f* are rather more than one-half the natural size.

straight *Bactrites*-like young of some forms of *Anarcestes*, the gyroceran young of others of the *Goniatitinæ*, and the gyroceran adults and young of *Mimoceras*, indicate the derivation of *Goniatitinæ* to have been from Silurian straight shells similar to *Bactrites*, if not directly from that genus itself" ("Genesis of the Arietidæ," Smithsonian Contrib. to Knowledge, 1889, p. 1).

Mimoceras compressum (Beyrich).

[Fig. 1, *n*, p. 4; Fig. 5, *a*, *b*, p. 34.]

1831. *Gyroceratites*, H. von Meyer, Nova Acta Acad. Cæs. Leop.-Carol. vol. xv. pt. 2, p. 73.

1832. *Spirula compressa*, Goldfuss, in von Dechen's Handb. de Geognosie von H. T. de la Beche, p. 536 (name only).

1837. *Gyroceratites gracilis*, H. G. Bronn, Lethæa Geogn. 2nd ed. vol. i. p. 102, pl. i. f. 6.

1837. *Ammonites compressus*, H. E. Beyrich, De Goniatitis in montibus rhenanis occurrentibus, p. 5, pl. i. ff. 6 *a*, *b*.

1837. *Ammonites compressus*, E. Beyrich, Beitr. Kenntn. Verstein. rhein. Uebergangsgeb. pt. i. p. 28, pl. i. ff. 6 *a*, *b*.

1842. *Goniatites compressus*, d'Archiac & de Verneuil, Trans. Geol. Soc. [2] vol. vi. pt. 2, p. 338 (*non* Münster).

1846–49. *Lituites gracilis*, F. A. Quenstedt, Petrefact. Deutschlands, vol. i. Cephalopoden, p. 64, pl. iii. f. 6.

1850. *Goniatites compressus*, F. A. Roemer, Palæontogr. vol. iii. p. 18, pl. iii. f. 27; and Beitr. geol. Kenntn. nordwestl. Harzgeb. pt. i. p. 18, pl. iii. f. 27.

1851. *Goniatites compressus*, G. Sandberger, Jahrb. Nassau Ver. Nat. vii. (ii. & iii.), pp. 294, 298, 301, 304, pl. ii. f. 1, pl. iii. ff. 18, 23, 25, 26.

1852. *Ammonites gracilis*, C. G. Giebel, Fauna der Vorwelt, vol. iii. pt. 1, p. 481.

1850–56. *Goniatites compressus*, G. & F. Sandberger, Verstein. rhein. Schichtensyst. Nassau, p. 120, pl. xi. ff. 4, 4 *a–g*.

1880. *Goniatites compressus*, W. Branco, Palæontogr. vol. xxvii. pt. 2, pp. 35–41, pl. viii. ff. ii. *a*, *b*, iii. *c–l*.

1881. *Goniatites compressus*, C. Koch, Jahrb. d. k. preuss. geol. Landesanst. u. Bergakad. for 1880, pp. 236, 241.

1883. *Goniatites gracilis*, F. A. Quenstedt, Handb. d. Petrefactenkunde, 3rd ed. pt. ii. p. 537, pl. xli. f. 28 (*non* Münster).

1884. *Mimoceras compressum*, A. Hyatt, Proc. Boston Soc. Nat. Hist. vol. xxii. p. 309.

1885. *Goniatites compressus*, E. Waldschmidt, Zeitschr. deutsch. geol. Gesell. vol. xxxvii. pp. 908, 909.

1889. *Goniatites compressus*, F. Sandberger, Jahrb. Nassau Ver. Nat., Jahrg. 42, p. 76.

[Not 1832. *Goniatites compressus* and *gracilis*, G. Münster, Ueber Planul. u. Goniat. p. 33.]

Sp. Char. Shell evolute, laterally compressed; greatest thickness at about the middle of the lateral area, about one-fifth of the diameter of the shell; height of outer whorl from two-fifths to nearly one-half of the diameter of the shell. Whorls four, evolute; umbilicus wide, shallow, exposing all the volutions. Whorl oval in section, higher than wide, in contact with, but not indented by, the

preceding whorl; periphery rounded in the septate part, but flattened and with subangular margins in the region of the body-chamber; sides and inner margin feebly convex, the latter not distinctly marked off from the lateral area. Body-chamber occupying about half a volution. Chambers not very deep; suture-line as in fig. 5, *b*, p. 34. Siphuncle slender. Test covered with numerous, fine, curved, somewhat squamose transverse lines, forming a shallow sinus on the sides of the shell, and a deep, linguiform, backwardly-directed sinus on the periphery. Initial chamber ovoid (see fig. 1, *n*, p. 4). Epidermids consisting of fine, irregular incised lines.

Size. Shell attaining a diameter of 40 mm.

Form. & Loc. Lower Devonian: Buntenbock, N.W. Hartz; Wissenbach, near Dillenburg, Nassau.

(i.) *Buntenbock, North-west Hartz.*

C. 3519 a–d. Two slabs containing several crushed examples, the largest being 22 mm. in diameter and showing the sculpture of the shell; also two crushed specimens 13 and 14 mm. in diameter respectively. *History unknown.*

(ii.) *Wissenbach, near Dillenburg, Nassau.*

The following specimens are casts in iron-pyrites, in matrix.

30267. One example, 19 mm. in diameter, partly buried in matrix; and a distorted specimen, whose greatest diameter is 23 mm., showing epidermids upon the anterior part of the cast of the body-chamber. *Purchased*, 1852.

48762. One specimen, 15 mm. in diameter. *Bright Collection.*

62498 a, b. One example 10 mm. in diameter, and a part of a specimen 19 mm. in diameter; the former showing the initial chamber. *Purchased*, 1868.

C. 1725. Nineteen specimens, ranging from 12 to 30 mm. in diameter. *Presented by John Edward Lee, Esq.*, 1885.

C. 1725 a, b. Two examples, 18 and 19 mm. in diameter respectively, showing the initial chamber somewhat indistinctly.
Presented by John Edward Lee, Esq., 1885.

C. 1725 c. One specimen, 20 mm. in diameter, much obscured by matrix, showing the slight median keel on the periphery of the body-chamber.
Presented by John Edward Lee, Esq., 1885.

C. 1726. One example, 17 mm. in diameter, labelled "*Goniatites gracilis*" in F. Roemer's handwriting. This specimen is shown, of the natural size, in fig. 5, *a*, p. 34.

Presented by John Edward Lee, Esq., 1885.

C. 1727, C. 1730 a. Two specimens, 15 and 18 mm. in diameter respectively. *Presented by John Edward Lee, Esq.*, 1885.

C. 1731, C. 1731 a. Two examples, 17·5 and about 27 mm. in diameter respectively, partly obscured by matrix; the smaller showing, on the cast of the body-chamber, the flattening of the periphery and the blunt keel on either side.

Presented by John Edward Lee, Esq., 1885.

C. 1734. Portion of specimen, 22 mm. in diameter. The cast of the body-chamber exhibits both the flattened periphery with one of its subangular margins, and also traces of the sculpture of the shell.

Presented by John Edward Lee, Esq., 1885.

C. 3515 a–d. Four specimens, ranging from 19 to 25 mm. in diameter. *Transferred from Mus. Pract. Geol.*

C. 3516. One crushed example, 16 mm. in diameter.

Transferred from Mus. Pract. Geol.

C. 3517 a, b. Two examples, 13 and 16 mm. in diameter respectively.

History unknown.

C. 3518. One specimen, about 15 mm. in diameter.

History unknown.

Mimoceras ambigena (Barrande).

1865. *Goniatites ambigena*, J. Barrande, Défense des Colonies, iii. p. 33.
1867. *Goniatites ambigena*, J. Barrande, Syst. Sil. de la Bohême, vol. ii. pt. 1, p. 28, pl. iii. ff. 17–22, pl. xii. ff. 4–7.
1882. *Aphyllites ambigena*, E. v. Mojsisovics, Abhandl. d. k.-k. geol. Reichsanst. vol. x. p. 181, footnote.
1884. *Mimoceras ambigena*, A. Hyatt, Proc. Boston Soc. Nat. Hist. vol. xxii. p. 309.

Sp. Char. Shell discoidal, flattened; greatest thickness at about the middle of the lateral area, about one-fifth of the diameter of the shell; height of outer whorl about two-fifths of the diameter of the shell. Whorls four; merely in contact, no inclusion; umbilicus wide, shallow. Whorl elongate-elliptical in section, much higher than wide; not indented by preceding whorl; periphery flat, with angular edges; sides feebly convex, somewhat flattened; inner margin rounded, not distinctly marked off from the lateral area, sloping

gently towards the umbilicus. Body-chamber occupying about half a whorl; aperture not seen, but form of peristome probably indicated by the direction of the lines of growth. Chambers not very deep; suture-line as in fig. 6. Siphuncle not seen. Test very thin,

Fig. 6.

Suture-line of *Mimoceras ambigena* (Barrande); reduced. Drawn from specimen No. 70971 *b*.

ornamented with subregular striæ, which form a rather shallow backwardly-directed sinus on the sides and a shallow backwardly-directed sinus on the periphery.

Size. Shell attaining a diameter of 38 mm.

Form. & Loc. Devonian (Étage G, bande g_3): Hlubočep, Bohemia.

Distinguished from *Mimoceras compressum* (Beyrich), its nearest ally, by the absence of a thread-like median keel on the periphery, by the deeper lateral lobe of its suture-line, and by its coarser ornaments.

70971 a, b. Two imperfect specimens, each about 33 mm. in diameter. *Purchased.*

Genus **ANARCESTES,** E. v. Mojsisovics[1].

Type. *Goniatites plebeius*, J. Barrande, Syst. Sil. de la Bohême, vol. ii. pt. 1, p. 37, pl. v.; pl. vi.; pl. vii. ff. 3–9, 12, 13; pl. ccxli. ff. 6–8; pl. ccxlii. ff. 2–10: 1867.

Gen. Char. Shell widely umbilicated, the first two whorls sometimes evolute. Body-chamber long, occupying one and a quarter whorls. Aperture with a deep peripheral sinus. Periphery broad. Suture-line simple, forming a shallow sinus on the sides of the shell; peripheral lobe infundibuliform; septal necks long, directed backwards. Initial chamber spherical.

Devonian.

Anarcestes lateseptatus (Beyrich).'

1837. *Ammonites lateseptatus*, H. E. Beyrich, De Goniatitis in montibus rhenanis occurrentibus, p. 4, pl. i. ff. 1–4.

1837. *Ammonites lateseptatus*, E. Beyrich, Beitr. Kenntn. Verstein. rhein. Uebergangsgeb. pt. i. p. 25, pl. i. ff. 1–4.

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[1] Abhandl. d. k.-k. geol. Reichsanst. vol. x. 1882, p. 181, footnote.

1842. *Goniatites lateseptatus*, d'Archiac & de Verneuil, Trans. Geol. Soc. [2] vol. vi. pt. 2, p. 338.
1850. *Aganides latiseptatus*, A. d'Orbigny, Prod. de Paléont. stratigr. vol. i. p. 61.
1852. *Ammonites lateseptatus*, C. G. Giebel, Fauna der Vorwelt, vol. iii. pt. i. p. 481.
1850–56. *Goniatites lateseptatus*, G. & F. Sandberger, Verstein. rhein. Schichtensyst. Nassau, p. 117, pl. xi. ff. 7, 7 *a–d*.
1860. *Goniatites lateseptatus*, F. A. Roemer, Beitr. geol. Kenntn. nordwestl. Harzgeb. pt. iv. p. 157, pl. xxiv. ff. 2 *a–c*.
1865. *Goniatites plebeius*, J. Barrande, Défense des Colonies, iii. p. 33.
1867. *Goniatites plebeius*, J. Barrande, Syst. Sil. de la Bohême, vol. ii. pt. i. p. 37, pl. v.; pl. vi.; pl. vii. ff. 3–9, 12, 13; pl. ccxli. ff. 6–8; pl. ccxlii. ff. 2–10.
1876. *Goniatites lateseptatus*, F. Maurer, Neues Jahrbuch, p. 826.
1878. *Goniatites lateseptatus*, E. Kayser, Abhandl. zur geol. Specialkarte von Preussen, vol. ii. pt. 4, p. 50, pl. vi.
1881. *Goniatites lateseptatus*, C. Koch, Jahrb. d. k. preuss. geol. Landesanst. u. Bergakad. for the year 1880, p. 241.
1882. *Anarcestes plebeius*, E. v. Mojsisovics, Abhandl. d. k.-k. geol. Reichsanst. vol. x. p. 181, footnote.
1885. Cf. *Goniatites lateseptatus*, E. Waldschmidt, Zeitschr. deutsch. geol. Gesell. vol. xxxvii. pp. 908, 916, pl. xxxviii. ff. 1, 1 *a*.
1887. *Goniatites* (*Anarcestes*) *lateseptatus*, F. Frech, Zeitschr. deutsch. geol. Gesell. vol. xxxix. pp. 685, 732, pl. xxxviii. ff. 12, 12 *a*.

Sp. Char. Shell discoidal; greatest thickness close to the umbilical margin, variable, from one-third to two-thirds of the diameter of the shell; height of outer whorl about one-third of the diameter of the shell. Whorls nine or ten (in adults); inclusion from one-half to two-thirds; umbilicus wide, deep, and with step-like sides. Whorl reniform in section, wider than high, but differing in proportion in different individuals; indentation by preceding whorl variable, from one-fifth to one-half; periphery broadly rounded; sides somewhat flattened; inner margin distinct, rather narrow, sloping towards the umbilicus. Body-chamber occupying a little more than an entire whorl; aperture not seen, but, judging from

Fig. 7.

Suture-line of *Anarcestes lateseptatus* (Beyrich). (After Sandberger.)

the ornaments of the test, probably with a slight sinus on each side and a well-marked peripheral sinus. Chambers rather deep, but

variable; suture-line of medium-sized specimen as in fig. 7, the lateral lobe becoming more pronounced in adults. Test ornamented with direct-imbricating striæ, forming a slight sinus on each side and a well-marked sinus on the periphery.

Size. Shell attaining a diameter of more than 140 mm.

Form. & Loc. Lower Devonian: Wissenbach, near Dillenburg, Nassau; N.W Hartz. Devonian (Étage G, bande g_3): Hluboč̌ep, Bohemia. Devonian: Torquay, S. Devon.

(i.) *Hluboč̌ep, Bohemia.*

70961. One somewhat imperfect example, about 110 mm. in diameter. *Purchased.*

70970. Twenty specimens, ranging from 16 to 78 mm. in diameter, representing Barrande's two varieties of this species, viz. *crassa* and *elliptica*. *Purchased.*

The following specimens probably belong to this species:—

(ii.) *Wissenbach, near Dillenburg, Nassau.*

C. 1728. A pyritized specimen, shown of the natural size in fig. 5, *c*, p. 34. A longitudinal groove is plainly visible on either side of the periphery.

Presented by John Edward Lee, Esq., 1885.

C. 1729 f, g. Two imperfect specimens, 9 and 18 mm. in diameter respectively. *Presented by John Edward Lee, Esq.*, 1885.

C. 1731 d. A pyritized specimen, 10 mm. in diameter, with a faint broad band on the periphery.

Presented by John Edward Lee, Esq., 1885.

C. 1733. A crushed and distorted pyritized example, having a very broad periphery, with a faint median keel.

Presented by John Edward Lee, Esq., 1885.

(iii.) *North-west Hartz.*

C. 3529. One example, about 27 mm. in diameter, in small slab; Buntenbock. *History unknown.*

C. 4450. A flattened specimen, 43 mm. in diameter, with traces of the ornamentation of the test; Clausthal.

History unknown.

(iv.) *Devon.*

30396. Small thin slab, displaying on each face a transverse section of the inner whorls of the same shell; the section on one

side is nearly median and passes through six whorls, the outermost having a diameter of 33 mm.; Torquay.

Purchased, 1852.

(v.) *Locality unknown.*

C. 1768. One abraded example, about 50 mm. in diameter.

Presented by John Edward Lee, Esq., 1885.

Anarcestes simulans (Barrande).

1865. *Goniatites simulans*, J. Barrande, Défense des Colonies, iii. p. 33.
1867. *Goniatites simulans*, J. Barrande, Syst. Sil. de la Bohême, vol. ii. pt. 1, p. 39, pl. ix. ff. 18–23.
1882. *Anarcestes simulans*, E. v. Mojsisovics, Abhandl. d. k.-k. geol. Reichsanst. vol. x. p. 181, footnote.

Sp. Char. Shell thick, discoidal; greatest thickness near the umbilical margin, about one-half of the diameter of the shell; height of outer whorl about one-third of the diameter of the shell. Whorls five (in adults); inclusion rather more than one-half; umbilicus wide and deep. Whorl reniform in section, wider than high, indented to rather more than one-third of its height by the preceding whorl; periphery broadly rounded; sides somewhat inflated; inner margin rounded. Body-chamber occupying rather more than a whorl; aperture not seen, but probably coincident with the ornaments of the shell. Chambers rather deep; suture-line as in fig. 8.

Fig. 8.

Suture-line of *Anarcestes simulans* (Barrande). Drawn from specimen No. 70972 *a*.

Test ornamented with very fine, subregular, inversely-imbricating striæ, having a slight sinus on the lateral area and a well-marked sinus on the periphery.

Size. Shell attaining a diameter of 36 mm., with a thickness of about 16 mm.

Form. & Loc. Devonian (Étage G, bande g_3): Hlubočep, Bohemia.

70972 a–c. Three examples, ranging from 23 to 27 mm. in diameter.

Purchased.

Anarcestes neglectus (Barrande).

1865. *Goniatites neglectus*, J. Barrande, Defénse des Colonies, iii. p. 33.
1867. *Goniatites neglectus*, J. Barrande, Syst. Sil. de la Bohême, vol. ii. pt. 1, p. 35, pl. iii. ff. 7–13.

1878. *Goniatites neglectus*, E. Kayser, Abhandl. zur geol. Specialkarte von Preussen, vol. ii. pt. 4, p. 53, pl. viii. ff. 8, 8 *a*, 8 *b*.
1882. *Anarcestes neglectus*, E. Mojsisovics, Abhandl. d. k.-k. geol. Reichsanst. vol. x. p. 181, footnote.
1884. *Anarcestes neglectus*, A. Hyatt, Proc. Boston Soc. Nat. Hist. vol. xxii. p. 309.

Sp. Char. Shell discoid, flattened; greatest thickness near the umbilical margin, about one-fifth of the diameter of the shell; height of outer whorl about one-third of the diameter of the shell. Whorls four to five; inclusion one-half; umbilicus wide, shallow. Whorl semi-elliptical in section, higher than wide, indented to nearly one-third of its height by the preceding whorl; periphery rounded; sides feebly convex, somewhat flattened and converging towards the periphery; inner margin rounded, not distinctly marked off from the lateral area. Body-chamber not fully known; aperture

Fig. 9.

Suture-line of *Anarcestes neglectus* (Barrande); reduced.
(After Barrande.)

unknown. Chambers not very deep; suture-line as in fig. 9. Test not well-preserved, apparently smooth.

Size. Shell attaining a diametero f less than 80 mm.

Form. & Loc. Devonian (Étage G, bande g_3): Hlubočep, Bohemia.

70978 a, b. Two specimens, 41 and 45 mm. in diameter respectively. *Purchased.*

Anarcestes Noeggerati (v. Buch).

1832. *Ammonites subnautilinus*, Schlotheim, Systematisches Verzeichniss der Petrefacten-Sammlung des verstorbenen wirklichen Geh.-Raths Freiherrn v. Schlotheim, p. 26 (name only).
1832. *Ammonites Noeggerati* (*Discites Noeggerati*, Goldfuss), v. Buch, Phys. Abhandl. k. Akad. Wiss. Berlin, for 1830, p. 166, pl. i. ff. 6, 7, 8.
1837. *Ammonites subnautilinus* (pars), E. Beyrich, Beitr. Kenntn. Verstein. rhein. Uebergangsgeb. pt. i. p. 24.
1842. *Goniatites Noeggerati*, d'Archiac & de Verneuil, Trans. Geol. Soc. [2] vol. vi. p. 337, pl. xxv. ff. 1 *a*, *b*.
1846–49. *Goniatites subnautilinus*, F. A. Quenstedt, Petrefact. Deutschlands, vol. i. Cephalopoden, p. 63, pl. iii. ff. 4 *a*, *b*.

1850. *Aganides Næggerathi*, A. d'Orbigny, Prod. de Paléont. stratigr. vol. i. p. 61.

1850–56. *Goniatites subnautilinus*, var. *typus*, G. & F. Sandberger, Verstein. rhein. Schichtensyst. Nassau, p. 114, pl. xi. ff. 1, 1 *a-f*.

1851. *Goniatites subnautilinus*, G. Sandberger, Jahrb. Nassau Ver. Nat. vii. (i.) p. 304, pl. iii. f. 27.

1852. *Ammonites subnautilinus* (pars), C. G. Giebel, Fauna der Vorwelt, vol. iii. pt. 1, p. 479.

? 1878. *Goniatites subnautilinus*, var. (?), E. Kayser, Abhandl. zur geol. Specialkarte von Preussen, vol. ii. pt. 4, p. 54, pl. vii.

? 1881. *Goniatites subnautilinus*, C. Koch, Jahrb. der königl. Preussischen geol. Landesanst. und Bergakad. for 1880, p. 241.

1884. *Goniatites subnautilinus*, var. *typus*=*Ammonites Noeggerati*, E. Beyrich, Zeitschr. deutsch. geol. Gesell. vol. xxxvi. p. 206.

? 1884. *Anarcestes subnautilinus*, A. Hyatt, Proc. Boston Soc. Nat. Hist. vol. xxii. p. 309.

1884. *Goniatites subnautilinus*, R. Hoernes, Elem. d. Palaeont. p. 331, woodc. fig. 457.

1887. *Goniatites Nöggerathii*, O. Follmann, Verhandl. naturh. Verein. preuss. Rheinl. u. Westf. p. 104.

1889. *Goniatites subnautilinus*, F. Sandberger, Jahrb. Nassau Ver. Nat., Jahrg. 42, p. 76.

1890. *Anarcestes subnautilinus*, G. Steinmann & L. Döderlein, Elem. d. Paläont. pt. ii. p. 373, f. 432; p. 392, ff. 469, 470 A.

Sp. Char. Shell (cast) thick, discoid, somewhat flattened upon the sides; greatest thickness near the umbilicus, about two-fifths of the diameter of the shell; height of outer whorl somewhat variable, from two-fifths to four-ninths of the diameter of the shell. Whorls nearly seven; inclusion three-fourths; umbilicus somewhat variable in size, from one-fourth to one-third of the diameter of the shell, deep, with step-shaped sides, exposing the inner whorls. Whorl elongate-oval in section, higher than wide; indented to about one-third or one-fourth of its height by the preceding whorl; periphery narrowly rounded or slightly flattened; sides feebly convex, flattened; inner margin narrow, forming an angle with the lateral area and descending almost perpendicularly into the umbilicus. Body-chamber occupying from one to one and a half whorls. Chambers rather deep, becoming much shallower near the body-chamber; suture-line as in fig. 5, *d*, p. 34. Test unknown, but cast of body-chamber sometimes crossed by waved transverse, not very prominent folds. Initial chamber of moderate size, globular.

Size. Shell attaining a diameter of 53 mm.

Form. & Loc. Lower Devonian: Wissenbach, near Dillenburg, Nassau; N.W. Hartz.

(i.) *Wissenbach, near Dillenburg, Nassau.*

62498. A pyritized example, 13 mm. in diameter. *Purchased.*

C. 1729 c, d, e. Three specimens, 11, 12, and 12 mm. in diameter respectively, probably belonging to this species.
Presented by John Edward Lee, Esq., 1885.

C. 1730 b, c. A well-preserved specimen, 35 mm. in diameter, and a crushed example, about 18 mm. in diameter.
Presented by John Edward Lee, Esq., 1885.

C. 1731 b, c. Two examples, 29 and 28 mm. in diameter respectively. *Presented by John Edward Lee, Esq.*, 1885.

C. 3526 a, b. A fairly well-preserved example, and an imperfect specimen, 34 and 17·5 mm. in diameter respectively.
Transferred from Mus. Pract. Geol.

C. 3531. A very imperfect specimen, 20 mm. in diameter, probably belonging to this species.
Transferred from Mus. Pract. Geol.

(ii.) *North-west Hartz.*

C. 3530. An example, about 31 mm. in diameter, in a small slab, associated with an example of *Agoniatites transitorius* ?, probably referable to this species; Hutthal.
History unknown.

Anarcestes subnautilinus (v. Buch).

1832. *Ammonites subnautilinus*, v. Buch, Phys. Abhandl. k. Akad. Wiss. Berlin, for 1830, p. 167, pl. i. ff. 9, 10, 11.
1837. *Ammonites subnautilinus* (pars), E. Beyrich, Beitr. Kenntn. Verstein. rhein. Uebergangsgeb. pt. i. p. 24.
1842. *Goniatites subnautilinus*, d'Archiac & de Verneuil, Trans. Geol. Soc. [2] vol. vi. p. 337.
1850. *Aganides subnautilinus*, A. d'Orbigny, Prod. de Paléont. stratigr. vol. i. p. 61.
1850–56. *Gonitaites subnautilinus*, var. *convolutus*, G. & F. Sandberger, Verstein. rhein. Schichtensyst. Nassau, p. 114, pl. xi. ff. 2, 2 *a*.
1852. *Ammonites subnautilinus* (pars), C. G. Giebel, Fauna der Vorwelt, vol. iii. pt. 1, p. 479.
1884. *Goniatites subnautilinus*, var. *convolutus*=*Ammonites subnautilinus*, E. Beyrich, Zeitschr. deutsch. geol. Gesell. vol. xxxvi. p. 206.
? 1887. *Goniatites subnautilinus*, O. Follmann, Verhandl. naturh. Verein. preuss. Rheinl. u. Westf. p. 105.
1889. *Goniatites convolutus*, F. Sandberger, Jahrb. Nassau Ver. Nat., Jahrg. 42, p. 76.
[Not 1832. *Ammonites subnautilinus*, v. Schlotheim, Systematisches

Verzeichniss der Petrefacten-Sammlung der verstorbenen wirklichen Geh.-Raths Freiherrn v. Schlotheim, p. 26.—1860. *Goniatites subnautilinus*, F. A. Roemer, Beitr. zur geol. Kenntn. des nordwestl. Harzgebirges, pt. iv. p. 158, pl. xxiv. ff. 3 *a–c*.]

The figures and descriptions hitherto given of this species, although supplemented by some imperfect specimens in the Collection, probably referable to this species, do not enable the writers to give a complete diagnosis of this apparently somewhat rare species. The following specific characters may, however, be noted :—

Shell (cast) discoidal, somewhat inflated; almost involute; umbilicus narrow, about one-fifth of the diameter of the shell. Periphery strongly convex, smooth, with feeble longitudinal lines; the central portion, bounded by a shallow groove on either side, and bearing one

Fig. 10.

Suture-line of *Anarcestes subnautilinus* (v. Buch). (After Sandberger.)

median and two lateral feeble narrow keels. Chambers of medium depth; suture-line as in fig. 10. Sides convex; inner area rounded, not defined.

Size. Shell attaining a diameter of between 20 and 30 mm.

Form. & Loc. Lower Devonian: Wissenbach, near Dillenburg, Nassau.

The following examples probably belong to this species:—

C. 1729 b. A crushed example, 28 mm. in diameter.
Presented by John Edward Lee, Esq., 1885.

C. 3527. An imperfect specimen, 10 mm. in diameter.
Transferred from Mus. Pract. Geol.

C. 3528. An example, 12 mm. in diameter, partly buried in matrix. *History unknown.*

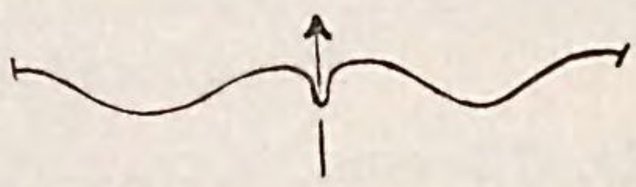
Anarcestes Ruppachensis (Kayser).

1850. *Goniatites subnautilinus*, F. A. Roemer, Palæontogr. vol. iii. (1) p. 19, pl. iii. ff. 28 *a*, *b*, *c*.
1850–56. *Goniatites subnautilinus*, var. *vittiger*, G. & F. Sandberger, Verstein. rhein. Schichtensyst. Nassau, p. 114, pl. xi. ff. 3, 3 *a–f* (non *vittiger*, J. Phillips).
1878. *Goniatites subnautilinus*, var. *vittiger*, E. Kayser, Abhandl. geol. Specialkarte Preussen, vol. ii. pt. 4, p. 57, footnote.

1879. *Goniatites Ruppachensis*, E. Kayser, Zeitschr. deutsch. geol. Gesell. vol. xxxi. p. 304, footnote.
1880. *Goniatites subnautilinus*, var. *vittiger*, W. Branco, Palæontogr. vol. xxvii. pl. vii. f. 1.
1881. *Goniatites Rupbachensis*, E. Kayser, Zeitschr. deutsch. geol. Gesell. vol. xxxiii. p. 620, footnote.
1884. *Goniatites vittatus*, E. Kayser, Jahrb. k. preuss. geol. Landesanst. u. Bergakad. for 1883, p. 46, pl. v. ff. 11–17.
1889. *Goniatites vittatus*, F. Sandberger, Jahrb. Nassau Ver. Nat., Jahrg. 42, p. 76.

Sp. Char. Shell much inflated in the young, becoming discoidal in the adult; greatest thickness near the umbilical border, varying from nearly one-half of the diameter of the shell in the young to about two-fifths of the diameter in the adult; height of outer whorl varying from about two-fifths of the diameter in the young (about 10 mm. in diameter) to rather more than one-half in the adult (about 60 mm. in diameter). Number of whorls doubtful; inclusion nearly one-half; umbilicus rather narrow, deep. Whorl in the young somewhat reniform in section, wider than high, becoming in the adult somewhat elliptical and higher than wide; indented by the preceding whorl to about one-fifth of its height in the adult; periphery flattened, with a broad smooth band bearing a filiform median line and bounded on either side by a proportionately broad feebly-convex keel included between two longitudinal shallow grooves, the latter becoming very indistinct in the adult. Sides inflated in the young, somewhat flattened in the adult; inner margin rounded. Body-chamber occupying half a whorl at least. Chambers rather shallow; suture-line as in fig. 11. Test ornamented with narrow rounded transverse ribs, which pass from the

Fig. 11.



Suture-line of *Anarcestes Ruppachensis* (Kayser). (After Kayser.)

umbilicus obliquely backwards for a short distance, then curve forwards, and, turning suddenly backwards at the keeled margin of the periphery, form a deep linguiform backwardly-directed sinus on the peripheral band. Initial chamber ellipsoidal, its length being in the direction of the axis of the shell.

This species is distinguished from *Goniatites crispus*, Barrande [1],

[1] Syst. Sil. de la Bohême, vol. ii. pt. i. p. 31, pl. ix. (1867).

and *Goniatites crispiformis*, Kayser [1], by its narrower umbilicus and the more rapid increase in height of its whorls.

Size. Shell attaining a diameter of about 60 mm. with a thickness of about 24 mm.

Form. & Loc. Lower Devonian: Clausthal, N.W. Hartz; Wissenbach, near Dillenburg, Nassau.

C. 1729 a. One example, 7 mm. in diameter, doubtfully referable to this species; Wissenbach, near Dillenburg, Nassau.
Presented by John Edward Lee, Esq., 1885.

C. 3535. A fairly well-preserved specimen, 21·5 mm. in diameter; Clausthal, N.W. Hartz. *History unknown.*

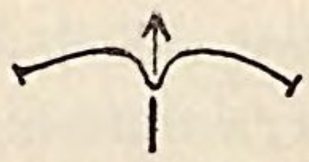
C. 4451. A cast in pyrites, 11 mm. in diameter; locality unknown.
History unknown.

Anarcestes cancellatus (d'Archiac & de Verneuil).

1842. *Goniatites cancellatus*, d'Archiac & de Verneuil, Trans. Geol. Soc. [2] vol. vi. p. 339, pl. xxv. f. 6.
1850. *Aganides cancellatus*, A. d'Orbigny, Prod. de Paléont. stratigr. vol. i. p. 58.
1852. *Ammonites cancellatus*, C. G. Giebel, Fauna der Vorwelt, vol. iii. p. 461.
1872. *Goniatites cancellatus*, E. Beyrich, Zeitschr. deutsch. geol. Gesell. vol. xxiv. p. 664, pl. xxvii. f. 6.
1887. *Goniatites* (*Anarcestes*) *cancellatus*, F. Frech, Zeitschr. deutsch. geol. Gesell. vol. xxxix. p. 433.

Sp. Char. Shell subglobular; greatest thickness at about the middle of the lateral area, rather more than one-half of the diameter; outer whorl completely enveloping all the others. Umbilicus closed, its position marked by a slight depression of the inner portion of the lateral area. Whorl subquadrate in section, indented to two-thirds of its height by the preceding whorl; periphery broadly

Fig. 12.



Suture-line of *Anarcestes cancellatus* (d'Archiac & de Verueuil).
(After Beyrich.)

rounded, coalescing with the sides by a continuous curve; sides inflated, their inner portion somewhat flattened and depressed. Suture-line as in fig. 12. "From the central depression radiate numerous

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[1] Zeitschr. deutsch. geol. Gesell. vol. xxxi. 1879, p. 301, pl. v. ff. 1 *a–d*.

striæ, which are very fine, at unequal distances, and often bifurcated. They are first directed forward near to the middle of the side, and then turn backward to form a broad and shallow sinus whose concavity is turned forward. At about two-thirds of the side, where the inflection of these striæ commences, other striæ, more delicate, but still regular and transverse, cross them obliquely, forming a slight undulation, thus producing an elegant chequer-work over the entire dorsal [peripheral] region of the shell."

Size. The specimen figured by d'Archiac and de Verneuil has a diameter of 26 mm. with a thickness of 14 mm.

Form. & Loc. Devonian: Grottenberg, near Bredelar, Westphalia.

C. 4464. One somewhat imperfect example, 21 mm. in diameter.

History unknown.

Anarcestes nuciformis (Whidborne).

1889. *Goniatites nuciformis*, G. F. Whidborne, Geol. Mag. [3] vol. vi. p. 29.

1890. *Goniatites nuciformis*, G. F. Whidborne, Devon. Fauna S. England, pt. i. (Pal. Soc.), p. 77, pl. vi. ff. 7, 7 *a*, 7 *b*; pl. vii. ff. 1, 1 *a*.

Sp. Char. Shell spheroidal, involute; greatest thickness at about the middle of the lateral area, about three-quarters of the diameter; height of outer whorl half the diameter. Umbilicus minute and very deep, so that the edges of the inner whorls are not visible. Whorl subquadrate in section, wider than high, indented to more than half its height by the preceding whorl; periphery broad,

Fig. 13.[1]

Suture-line of *Anarcestes nuciformis* (Whidborne). (After Whidborne.)

slightly convex; sides convex, a little flattened near the umbilicus. Chambers of medium depth; suture-line as in fig. 13. "Siphuncle large." Test unknown.

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[1] This figure is copied from pl. vi. fig. 7 *a* of Mr. Whidborne's Monograph. Respecting the "rudimentary central lobe and central saddles" here represented Mr. Whidborne observes:—"Though the draughtsman thought he traced them, and I therefore permitted them to stand, I myself believe that they have no existence, and that they ought to be replaced by a continuation of the simple curve."

Size. The largest known example has a diameter of 17 mm. with a thickness of 12 mm.

Form. & Loc. Middle Devonian: Wolborough, S. Devon.

36624. One small imperfect example, 10 mm. in diameter.

Purchased, 1857.

Genus **AGONIATITES,** Meek[1].

Syn. *Aphyllites,* Mojsisovics, Abhandl. d. k.-k. geol. Reichsanst. vol. x. 1882, p. 181, footnote.

Type. *Goniatites expansus*, L. Vanuxem, Nat. Hist. N. York, Part IV. Geology, pt. iii. Third Geol. District, p. 146, f. 1.

Shell with a narrow or a moderately wide umbilicus. Body-chamber occupying only one-half or two-thirds of the last whorl. Suture-line with a rather deep lateral sinus; a small antiperipheral lobe present.

Agoniatites Bohemicus (Barrande).

[Fig. 5, *e*, *f*, p. 34.]

1865. *Goniatites Bohemicus,* J. Barrande, Défense des Colonies, iii. p. 33.

1867. *Goniatites Bohemicus,* J. Barrande, Syst. Sil. de la Bohême, vol. ii. pt. 1, p. 29, pl. i. ff. 1–13, pl. ii. ff. 1, 2, pl. iii. ff. 15, 16, pl. ccxlii. f. 1, pl. ccxliv. ff. 3, 4.

1878. *Goniatites evexus,* v. Buch, var. *bohemica,* E. Kayser, Abh. geol. Specialkarte Preussen, vol. ii. pt. 4, p. 63, pl. viii. f. 1.

1882. *Aphyllites Bohemicus,* E. v. Mojsisovics, Abh. k.-k. geol. Reichsanst. vol. x. p. 181, footnote.

Sp. Char. Shell discoidal, flattened; greatest thickness close to the umbilicus, variable, generally not exceeding one-fourth of the diameter of the shell; height of outer whorl about half the diameter. Whorls about four; inclusion somewhat variable, about one-fourth; umbilicus wide and open. Whorl subtriangular in section, higher than wide, slightly indented by preceding whorl; periphery somewhat flattened; inner margin rounded. Body-chamber occupying rather more than half a whorl. Chambers, measured on the middle of the lateral area, one-sixth of the corresponding ventro-dorsal diameter in depth; suture-line as in fig. 14; a shallow antisiphonal lobe present. Test ornamented with deep striæ, separated by intervals of greater width than the striæ; ornament following nearly the direction of the sutures, but the forward projection corresponding to the siphonal saddle is

[1] U.S. Geol. Explor. 40th parallel, vol. iv. 1877, pt. 1, p. 99.

upon the lateral area at some distance from the periphery. In the young shell a shallow groove parallel with the periphery connects the summits of these projections.

Fig. 14.

Suture-line of *Agoniatites Bohemicus* (Barrande), reduced. (After Barrande.)

Size. Shell attaining a diameter of more than 230 mm., with a thickness of 80–90 mm.

Form. & Loc. Étage F (Devonian): Hlubočep, Bohemia.

70960 a, b. Two large imperfect examples, 195 and 160 mm. in diameter respectively, displaying the ornamentation of the test. *Purchased.*

70976 a–h. Eight specimens, ranging from 60 to 127 mm. in diameter, some showing the test and others the form of the suture-line. One of the specimens (70976 *a*) is drawn of rather more than one-half the natural size in fig. 5, *e*, *f*, p. 34. *Purchased.*

Agoniatites fidelis (Barrande).

1865. *Goniatites fidelis*, J. Barrande, Défense des Colonies, iii. p. 33.
1867. *Goniatites fidelis*, J. Barrande, Syst. Sil. de la Bohême, vol. ii. pt. 1, p. 33, pl. viii. ff. 1–23, pl. ix. ff. 9, 10.
1882. *Aphyllites fidelis*, E. v. Mojsisovics, Abh. k.-k. geol. Reichsanst. vol. x. p. 181, footnote.
1884. *Agoniatites fidelis*, A. Hyatt, Proc. Boston Soc. Nat. Hist. vol. xxii. p. 310.

Sp. Char. Shell discoidal; greatest thickness near the umbilicus, from one-third to two-thirds of the diameter; height of outer whorl half the diameter. Whorls six; inclusion about five-sixths; umbilicus narrow and rather deep. Whorl subelliptical in section, higher than wide, indented to nearly one-third of its height by the preceding whorl; periphery flattened; sides flattened in the young. Body-chamber occupying half a whorl. Septa with a well-marked rounded concavity situated nearer the dorsal area than the periphery; distant on the middle of the lateral area about one-fifth of the corresponding ventro-dorsal diameter; suture-line as in fig. 15; antisiphonal lobe rounded and shallow. Test ornamented with fine, subregular striæ, which form a shallower sinus than the

suture-line on the sides of the shell, and a rounded deep sinus in crossing the periphery; at a certain age small shallow pits occur between the striæ.

Fig. 15.

Suture-line of *Agoniatites fidelis* (Barrande), reduced. (After Barrande.)

Kayser ('Abhandl. geol. Specialkarte Preussen,' vol. ii. pt. 4, 1878, p. 54) considers it probable that *Gon. fidelis* represents only an extreme narrowly-umbilicated variety of *Gon. subnautilinus*[1].

Size. Shell attaining a diameter of 130 mm., with a thickness of 70 mm.

Form. & Loc. Étage F (Devonian): Mnienian and Hlubočep, Bohemia.

70974. Three specimens, 33, 41, and 19 mm. in diameter respectively. Hlubočep, Bohemia. *Purchased.*

70974 a. Three examples; the largest (44 mm. in diameter) showing the structure of the test, a smaller and very imperfect specimen (32 mm. in diameter) exhibiting the siphuncle. Mnienian. *Purchased.*

Agoniatites verna (Barrande).

1865. *Goniatites verna*, J. Barrande, Défense des Colonies, iii. p. 34.
1867. *Goniatites verna*, J. Barrande, Syst. Sil. de la Bohême, vol. ii. pt. 1, p. 46, pl. ix. ff. 1–8, 11–13.
1878. *Goniatites evexus*, E. Kayser, Abh. geol. Specialkarte Preussen, &c. vol. ii. pt. 4, p. 58 (in part.).
1882. *Aphyllites verna*, E. v. Mojsisovics, Abh. k.-k. geol. Reichsanst. vol. x. p. 181, footnote.
1884. *Agoniatites verna*, A. Hyatt, Proc. Boston Soc. Nat. Hist. vol. xxii. p. 311.

Sp. Char. Shell discoidal; greatest thickness near the umbilicus, one-third of the diameter; height of outer whorl about half the diameter. Whorls four; inclusion nearly two-thirds, but somewhat variable; umbilicus more or less contracted. Whorl oval in section, higher than wide, indented to one-third or one-fourth of its height by the preceding whorl; periphery rounded. Body-chamber occupying about half a whorl. Chambers, measured at the middle of the lateral area, about one-sixth of the corresponding ventro-

[1] See *antea*, p. 43.

dorsal diameter in depth; suture-line as in fig. 16. Test about 1 mm. in thickness, outer layer ornamented with fine, subregular, direct-imbricating striæ, inner layer smooth.

Fig. 16.

Suture-line of *Agoniatites verna* (Barrande), reduced. (After Barrande.)

Size. Shell attaining a diameter of 40 to 45 mm., with a thickness of about 15 mm.

Form. & Loc. Étage F (Devonian): Hlubočep, Bohemia.

70972 d. One example, 34 mm. in diameter, showing the septa.
Purchased.

70977 a–e. Five specimens, varying from 37 to about 45 mm. in diameter; in the first of these the suture-line is well shown.
Purchased.

Agoniatites occultus (Barrande).

1865. *Goniatites occultus*, J. Barrande, Défense des Colonies, iii. p. 33.
1867. *Goniatites occultus*, J. Barrande, Syst. Sil. de la Bohême, vol. ii. pt. 1, p. 36, pl. ix. ff. 14–17.
1876. *Goniatites occultus*, F. Maurer, Neues Jahrb. p. 823.
1881. *Goniatites occultus*, C. Koch, Jahrb. k. preuss. geol. Landesanst. (for 1880), Wiss. Mitth. p. 241.
1882. *Aphyllites occultus*, E. v. Mojsisovics, Abh. k.-k. geol. Reichsanst. vol. x. p. 181, footnote.
1884. *Goniatites occultus*, E. Kayser, Jahrb. k. preuss. geol. Landesanst. (for 1883), Abh. p. 49, pl. v. ff. 8–10, pl. vi. f. 10.
1885. *Goniatites occultus*, E. Waldschmidt, Zeitschr. deutsch. geol. Gesell. vol. xxxvii. p. 918.

Sp. Char. Shell discoidal, flattened; greatest thickness close to the umbilicus, about one-third of the diameter; height of outer whorl rather more than half the diameter. Whorls about three; inclusion four-fifths; umbilicus narrow and relatively deep. Each whorl bears a very distinct groove adjacent to, and parallel with, the periphery; portion of the whorl external to this groove depressed; periphery gently convex; whorl semi-elliptical in section, higher than wide, indented to about one-third of its height by the preceding whorl. Body-chamber occupying rather more than half a whorl. Chambers, measured at the middle of the lateral area, one-seventh of the corresponding ventro-dorsal diameter in depth; suture-line as in fig. 17.

Size. Shell attaining a diameter of 60 mm., with a thickness of from 18 to 20 mm.

Form. & Loc. Étage G, bande g_3 (Devonian) : Hlubočep, Bohemia.

Fig. 17.

Suture-line of *Agoniatites occultus* (Barrande). (After Barrande.)

70975. Two specimens, 66 and 53 mm. in diameter respectively. The larger specimen is much crushed and probably exceeds its original diameter. *Purchased.*

Agoniatites tabuloides (Barrande).

1865. *Goniatites tabuloides*, J. Barrande, Défense des Colonies, iii. p. 33.

1867. *Goniatites tabuloides*, J. Barrande, Syst. Sil. de la Bohême, vol. ii. pt. 1, p. 41, pl. iv. ff. 1–12.

1878. *Goniatites tabuloides*, E. Kayser, Abhandl. geol. Specialkarte Preussen, vol. ii. pt. 4, p. 57, pl. viii. ff. 2, 3.

1882. *Aphyllites tabuloides*, E. v. Mojsisovics, Abh. k.-k. geol. Reichsanst. vol. x. p. 181, footnote.

1884. *Agoniatites tabuloides*, A. Hyatt, Proc. Boston Soc. Nat. Hist. vol. xxii. p. 311.

Sp. Char. Shell discoidal, much flattened; greatest thickness near the umbilicus, varying from about one-fourth of the diameter in the young to about one-sixth of the diameter in the adult; height of outer whorl rather more than half the diameter. Whorls five; inclusion one-fifth; umbilicus very wide and open. Whorl subtriangular in section, much higher than wide, slightly indented by preceding whorl; periphery narrow, rounded; sides feebly convex; inner margin perpendicular to plane of symmetry. Body-chamber occupying half a whorl. Chambers, measured at the middle of the lateral area, about 7 mm. in depth in an adult specimen of 120 mm. in diameter; suture-line as in fig. 18;

Fig. 18.

Suture-line of *Agoniatites tabuloides* (Barrande), reduced. (After Barrande.)

antisiphonal lobe very shallow. Test ornamented with inverse-imbricating strong striæ or small folds, which follow the curve of the suture-line on the lateral area and form a deep sinus on the periphery.

Size. Shell attaining a diameter of 120 mm., with a thickness of 20 mm.

Form. & Loc. Étage G, bande g_3 (Devonian): Hlubočep, Bohemia.

70973. Four specimens, ranging from 49 to 95 mm. in diameter; two specimens show the test, the others the septa.
Purchased.

Agoniatites fecundus (Barrande).

1865. *Goniatites fecundus*, J. Barrande, Défense des Colonies, iii. p. 33.
1867. *Goniatites fecundus*, J. Barrande, Syst. Sil. de la Bohême, vol. ii. pt. 1, p. 32, pl. vii. ff. 10, 11, pl. x. ff. 8–18, pl. xi. ff. 1–20, pl. xvii. ff. 10, 11, 12.
1878. *Goniatites evexus*, E. Kayser, Abh. geol. Specialkarte Preussen, &c. vol. ii. pt. 4, p. 58 (in part.).
1882. *Aphyllites fecundus*, E. v. Mojsisovics, Abh. k.-k. geol. Reichsanst. vol. x. p. 181, footnote.
1884. *Agoniatites fecundus*, A. Hyatt, Proc. Boston Soc. Nat. Hist. vol. xxii. p. 311.

Sp. Char. Shell discoidal, flattened, and widely umbilicated; greatest thickness near the umbilicus, nearly one-third of the diameter; height of outer whorl about half the diameter. Whorls six; no inclusion, whorls merely touching. Whorl subtriangular in section, higher than wide, not indented by preceding whorl; periphery flattened; inner margin convex. Body-chamber occupying about half a whorl; aperture with a deep peripheral sinus and a wide lateral sinus. Chambers attaining a depth of 7 mm., measured on the middle of the lateral area; suture-line as in fig. 19.

Fig. 19.

Suture-line of *Agoniatites fecundus* (Barrande). (After Barrande[1].)

Test ornamented with prominent folds, which form a shallow sinus on the side and a deeper sinus on the periphery; each fold bears from 3–7 striæ; folds not always present in the young. Initial chamber sometimes spherical, sometimes ellipsoidal.

Size. Shell attaining a diameter of 90 mm.

Form. & Loc. Étage H (Devonian): Krzenkowitz, Bohemia.

70900. Ten small slabs containing crushed specimens, the majority exhibiting the ornamentation of the test. *Purchased.*

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[1] *Op. cit.* pl. x. ff. 14 *d* and 16 combined.

70900 a. Small slab bearing a specimen showing the initial chamber. *Purchased.*

70900 b. Small slab containing a crushed example showing the suture-line. *Purchased.*

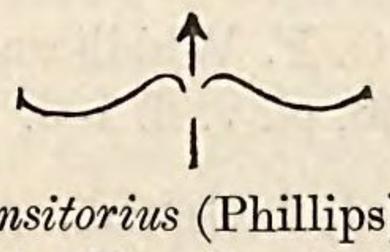
70900 c. Small slab, in counterpart, containing a fragment of the test. *Purchased.*

Agoniatites transitorius (Phillips).

1841. *Goniatites transitorius*, J. Phillips, Pal. Foss. Cornwall &c. (Mem. Geol. Surv.), p. 140, pl. lx. f. 227* [Mus. Pract. Geol.].
1850. *Aganides transitorius*, A. d'Orbigny, Prod. de Paléont. stratigr. vol. i. p. 61.
1851. *Goniatites bicanaliculatus*, G. & F. Sandberger, Verst. rhein. Schichtensyst. Nassau, p. 112, pl. xi. ff. 5 *a–g*, 6 *a–f* (? not 5 *h–k*).
1852. *Ammonites* (*Goniatites*) *transitorius*, C. G. Giebel, Fauna der Vorwelt, vol. iii. (Mollusca), p. 746.
1878. *Goniatites evexus*, E. Kayser, Abh. geol. Specialkarte Preussen, &c. vol. ii. pt. 4, p. 58 (in part.).
? 1880. *Goniatites evexus*, W. Branco, Palæont. vol. xxvii. pl. vii. f. 2.
1884. *Agoniatites bicanaliculatus*, A. Hyatt, Proc. Boston Soc. Nat. Hist. vol. xxii. p. 310.
1890. *Goniatites transitorius*, G. F. Whidborne, Devon. Fauna S. England, pt. ii. (Pal. Soc.), p. 61, pl. v. ff. 7–10, pl. vi. ff. 8, 8 *a*.

Sp. Char. Shell flattish, ellipsoidal; greatest thickness near the edge of the umbilicus, nearly one-third of the diameter; height of outer whorl rather more than two-fifths of the diameter. Whorls about four; inclusion about one-half; umbilicus very open and rather shallow, nearly one-third of the diameter in width. Whorl subtriangular in section, truncated at the periphery and rounded at the lateral angles; about as wide as high, indented to about a quarter of its height by the preceding whorl. Periphery broad, subconvex, laterally angulated, and limited on each side by an indistinct lateral groove. Margin of the aperture with a lateral

Fig. 20.



Suture-line of *Agoniatites transitorius* (Phillips). Drawn from Phillips's type in the Mus. Pract. Geol.

sinus and a sharp, overhanging, peripheral projection. Septa oblique, and, measured at the middle of the lateral area, a little more than one-third of the corresponding ventro-dorsal diameter apart; suture-line as in fig. 20. Test ornamented with curved

subregular striæ, which form a deep, rounded, backwardly-directed sinus on the periphery.

Size. Shell attaining a diameter of 28 mm., with a thickness of 9 mm.

Form. & Loc. Lower Devonian: Ruppach (Nassau), Bundenbach, and N.W. Hartz, Germany. Middle Devonian: Wolborough, S. Devon.

23707. One specimen, partly imbedded in matrix, figured by Whidborne, *op. cit.* pl. v. f. 7; Wolborough, S. Devon.
Purchased, 1849.

36279. One example, partly obscured by matrix, figured by Whidborne, *op. cit.* pl. v. f. 8; Wolborough, S. Devon.
Purchased, 1856.

C. 1494. Four crushed and imperfect specimens; Bundenbach, Germany. *Purchased*, 1886.

C. 1732. One well-preserved example, 19 mm. in diameter, labelled "*Goniatites bicanaliculatus*" in F. Roemer's handwriting; Ruppach (Nassau), Germany.
Presented by John Edward Lee, Esq., 1885.

C. 1736. One somewhat crushed specimen, 34 mm. in diameter, labelled "*Goniatites subnautilinus*" in F. Roemer's handwriting; Ruppach (Nassau), Germany.
Presented by John Edward Lee, Esq., 1885.

C. 4448. Flattened specimen, 38 mm. in diameter, on small slab; N.W. Hartz. *History unknown.*

C. 4449. One flattened example, 35 mm. in diameter, probably belonging to this species; Clausthal, N.W. Hartz.
History unknown.

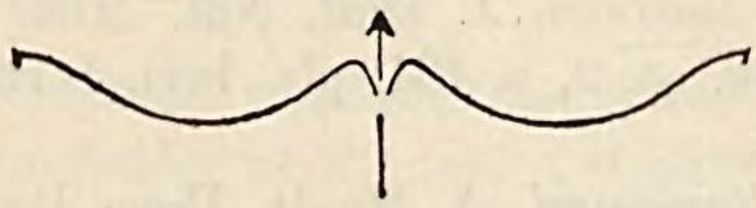
Agoniatites obliquus (Whidborne).

1889. *Goniatites obliquus*, G. F. Whidborne, Geol. Mag. [3] vol. vi. p. 29.
1890. *Goniatites obliquus*, G. F. Whidborne, Devon. Fauna S. England, pt. ii. (Pal. Soc.), p. 56, pl. v. ff. 1–3.

Sp. Char. Shell discoidal, flattened; greatest thickness close to the umbilicus, rather more than one-third of the diameter; height of outer whorl about half the diameter. Whorls four or five; inclusion about one-half or three-quarters; umbilicus wide, shallow, about one-quarter of the diameter of the shell, scalariform, showing upon its sides the convex inner areas of the whorls. Whorl sub-

triangular in section, higher than wide, indented to about one-fourth of its height by the preceding whorl; periphery flattened; sides flattened; inner margin convex, sloping. Septa forwardly inclined; chambers shallow; suture-line as in fig. 21. Test on body-

Fig. 21.



Suture-line of *Agoniatites obliquus* (Whidborne). Drawn from the specimen in Mr. Vicary's Collection figured by G. F. Whidborne, *loc. cit.* pl. v. f. 1; and reduced.

chamber apparently smooth, on inner whorls (as seen within the umbilicus) with coarse radiating ribs.

Mr. Whidborne regards (*op. cit.* p. 56) *Goniatites planidorsatus*, Geinitz[1] (*non* Münster[2]), as a synonym of this species, but the shape of the suture-line suffices to distinguish the two forms.

Size. Shell attaining a diameter of more than 155 mm., with a thickness of 43 mm.

Form. & Loc. Middle Devonian: Wolborough and Barton, S. Devon.

C. 1740. Crushed specimen, the suture-line of which is figured by Whidborne, *op. cit.* pl. v. f. 2; Wolborough, S. Devon. Owing to the distorted condition of the specimen, the lateral lobe of the suture-line is exaggerated in depth and diminished in width; there is no indication of a small median saddle. The suture-line is, in fact, that of a typical *Agoniatites*.

Presented by John Edward Lee, Esq., 1885.

C. 3793. Polished slab, in counterpart, displaying median transverse section of shell, which, though imperfect, measures 155 mm. in diameter; Barton, Torquay, Devon.

Purchased, 1891.

Agoniatites Vanuxemi (Hall).

1842. *Goniatites expansus*, L. Vanuxem, Nat. Hist. N. York, Pt. IV. Geology, pt. iii. Third Geol. District, p. 146, f. 1 (*non* von Buch).

1852. *Ammonites subnautilinus* (pars), C. G. Giebel, Fauna der Vorwelt, vol. iii. (Mollusca), p. 480.

1860. *Goniatites expansus*, J. Hall, Thirteenth Rep. N. York State Cab. Nat. Hist. pp. 96, 97, ff. 1, 2.

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[1] Verst. Grauw. Sachsen, 1852, pt. ii. p. 39, pl. xi. figs. 4–6.

[2] Beiträge, pt. i. 1st ed. 1839, p. 21, pl. iii. fig. 7; 2nd ed. 1843, p. 47, pl. iii. f. 7.

1876. *Goniatites expansus*, J. Hall, Nat. Hist. N. York, Illustr. Devon. Foss., Cephalopoda, pls. lxiv. A, lxvi.–lxix.
1877. *Goniatites* [*Agoniatites*] *expansus*, F. B. Meek, U.S. Geol. Explor. 40th parallel, vol. iv. pt. 1, p. 99, footnote.
1878. *Goniatites evexus*, E. Kayser, Abh. geol. Specialkarte Preussen, &c. vol. ii. pt. 4, p. 38 (in part.).
1879. *Goniatites Vanuxemi*, J. Hall, Nat. Hist. N. York, Pt. VI. Palæont. vol. v. pt. 2, p. 434, pls. lxvi.–lxviii., pl. lxix. ff. 3–6, pl. cix. ff. 7, 8.
1884. *Agoniatites Vanuxemi*, A. Hyatt, Proc. Boston Soc. Nat. Hist. vol. xxii. p. 310.
1886. *Goniatites Vanuxemi*, J. Hall, Geol. Surv. N. York, Fifth Ann. Rep. State Geologist, pl. (cxxvii.) 12. ff. 3–6.
1888. *Goniatites Vanuxemi*, J. Hall, Nat. Hist. N. York, Pt. VI. Palæont. vol. v. pt. 2, Suppl. p. 39, pl. cxxvii. ff. 3–6.

Sp. Char. Shell discoidal, flattened upon the sides and upon the periphery in its advanced stages of growth ; greatest thickness close to the umbilicus, varying according to the age of the shell from one-half to one-third of the diameter ; the younger forms are much more rotund ; height of outer whorl about one-half the diameter. Whorls about three or four ; inclusion varying according to the age of the shell from one-half in the young to two-thirds in the adult. Umbilicus large, open, exposing portions of the inner whorls, varying according to the age of the shell from rather more than one-third of the diameter in the young to about one-fifth or one-sixth of the diameter in the adult; margin obtusely angular. Whorl elongate-trapezoidal in section, higher than wide, becoming more elongate as the shell advances in age, indented to about one-fifth of its height by preceding whorl; periphery flattened ; sides slightly convex near the umbilicus, flattened near the periphery ; inner margin convex, in the adult almost at right angles to the plane of symmetry. Body-chamber occupying two-thirds of a whorl ; aperture slightly expanded on lateral margins, much expanded near the umbilicus, with a deep peripheral sinus and a wide shallower lateral sinus.

Fig. 22.

Suture-line of *Agoniatites Vanuxemi* (Hall). Drawn from a specimen in the British Museum (No. 34909), and reduced.

Chambers, measured on the middle of the lateral area, about one-fourth of the corresponding ventro-dorsal diameter in depth ; suture-line as in fig. 22. Test from 1 to 2 mm. thick on adult individuals ;

its surface with strong, lamellose, curving striæ, and in the young also with curving rounded ridges. Periphery bounded on either side by two grooves, which disappear as the shell enlarges.

Size. Shell attaining a diameter of 300 mm.

Form. & Loc. Marcellus Shale, Hamilton Group (Middle Devonian): New York State.

34909. Imperfect specimen (162 mm. in diameter), lateral aspect, showing sculpture of the test and form of the suture-line. Locality uncertain, but probably from the Marcellus Shale, Hamilton Group (Middle Devonian): New York State. *Purchased*, 1855.

C. 4410 a, b. Two examples (one 71 mm. in diameter, the other somewhat larger) displaying the curving annular ridges of the young shell; Cazenovia, New York State. *History unknown.*

The two other genera belonging to this family (*Pinacites* and *Celœceras*) are not represented in the Collection.

Family PRIMORDIALIDÆ.

(*Primordiales*, Beyrich, and *Crenati*, Sandberger.)

Peripheral (external) lobe wide, divided by a median saddle; only one lateral lobe present.

Genus **GEPHYROCERAS,** A. Hyatt[1].

Syn. *Manticoceras*, A. Hyatt, op. cit. p. 317.
Timanites, E. v. Mojsisovics, Abhandl. d. k.-k. geol. Reichsanst. vol. x. 1882, p. 183.

Type. *Goniatites sinuosus*, J. Hall, Nat. Hist. N. York, Pt. VI. Palæont. vol. v. pt. 2, p. 460, pl. lxx. ff. 13–15, pl. lxxii. f. 11, pl. lxxiv. f. 11 (1879).

Gen. Char. Shell involute or umbilicated, with rounded periphery. Suture-line with a single deep lateral lobe; a wide outer[2] saddle; and a broad peripheral lobe, divided by a median saddle, which sometimes attains a considerable size. First septum without peripheral saddle. Siphonal necks short, directed backwards. The inner whorls sometimes discoidal, compressed; sometimes widely umbilicated with a broadly-rounded periphery.

Devonian.

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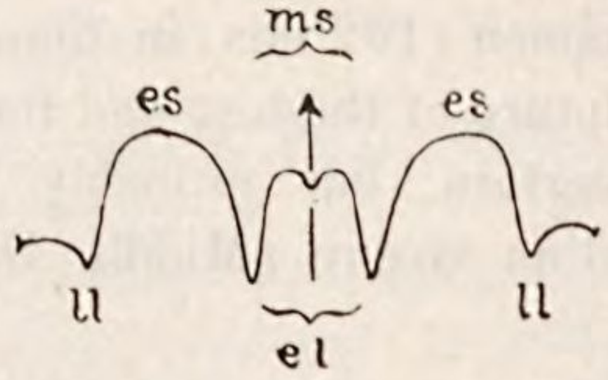
[1] Proc. Boston Soc. Nat. Hist. vol. xxii. 1884, p. 316.

[2] Lateral saddle of some authors.

Remarks. Prof. Hyatt's genus *Gephuroceras* includes "species with discoidal young, whorls with broad and more or less flattened abdomens [peripheries] in the adolescent stages, and the sides divergent as in *Manticoceras*. There is a decided resemblance to

Fig. 23.



Suture-line of *Gephyroceras intumescens* (Beyrich), three-fifths nat. size. (After Sandberger.) *ms*, median saddle; *el*, peripheral, external or outer lobe; *es*, peripheral, external or outer saddle (lateral saddle, of some authors); *ll*, lateral lobe.

the adult of this genus, especially to *Man. latidorsatum*, but the larval and adolescent stages in the radical species are separable by means of their flattened abdomen [periphery] and less rapidly growing whorls. The adult whorls become compressed and sub-acute in several species, but retain their open umbilici except in the most involute species."

The genus *Manticoceras* of the same author includes "species with compressed and often very involute whorls, which are, however, directly traceable by the closest gradations into forms with broad whorls, open umbilici, and an aspect similar to that of *Anarcestes*. The young are invariably less discoidal than in *Gephuroceras*, the abdomens [peripheries] rounded, and the sides divergent outwardly. . . . . The adult sutures have the same general aspect as those of *Gephuroceras*, but the septa in the compressed involute forms become more decidedly convex. The lobes remain rounded until later stages of the growth, the funnel-lobes are generally smaller, the large lateral saddles are also more persistent and retain their forms unchanged even in the extreme old ages of the largest specimens."

Some authors[1], however, seem to regard the distinctions relied upon by Prof. Hyatt to separate these two genera as not of generic importance; and we have followed these authors, preserving the

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[1] F. Frech, Zeitschr. deutsch. geol. Gesell. vol. xxxix. (1887), pp. 428, 432: *Goniatites* (*Gephyroceras*) *intumescens*, which Hyatt refers to *Manticoceras*; and *Goniatites* (*Gephyroceras*) *calculiformis*, referred by Hyatt to *Gephyroceras*. See also K. A. von Zittel, Handb. d. Palæont. vol. ii. p. 418 (1884).

name *Gephuroceras* (or *Gephyroceras* as corrected by Zittel and used by subsequent writers) for this genus.

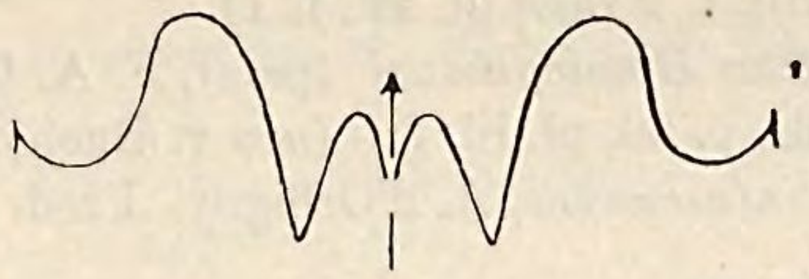
Without giving any description of the genus, Mojsisovics [1] assigned the generic name *Timanites* to the *Goniatites acutus*, v. Keyserling (Petschora-Land, p. 280, pl. xii. ff. 6 *a*, *b*),—a species which Hyatt himself includes in his *Gephuroceras*; but as this genus cannot, we think, be regarded as sufficiently characterized, we have, following Dr. Zittel, considered it to be a synonym of *Gephyroceras*.

Gephyroceras forcipifer? (G. & F. Sandberger).

1850–56. *Goniatites forcipifer*, G. & F. Sandberger, Verstein. rhein. Schichtensyst. Nassau, p. 81, pl. vi. ff. 3 *a*, *b*, *c*.
1852. *Ammonites forcipifer*, C. G. Giebel, Fauna der Vorwelt, vol. iii. p. 467.
1882. *Goniatites forcipifer*, E. Holzapfel, Palæontogr. vol. xxviii. p. 246.
1884. *Gephuroceras forcipifer*, A. Hyatt, Proc. Boston Soc. Nat. Hist. vol. xxii. p. 317.
1887. *Goniatites* (*Gephyroceras*) *forcipifer*, F. Frech, Zeitschr. deutsch. geol. Gesell. vol. xxxix. p. 428.

Sp. Char. Shell discoidal, flattened; greatest thickness at a short distance from the umbilicus, about two-ninths of the diameter; height of outer whorl three-sevenths of the diameter of the shell. Whorls four or five; inclusion one-half; umbilicus rather large, about two-sevenths of the diameter of the shell in width. Whorl lanceolate in section, higher than wide; periphery almost flat, with a feebly-marked groove in the median line; sides concave near the

Fig. 24.



Suture-line of *Gephyroceras forcipifer* (G. & F. Sandberger).
(After Sandberger.)

periphery, the rest convex; inner margin rounded. Chambers shallow; suture-line as in fig. 24. Test thin, almost smooth, with simple curved, slightly-falciform ribs, distinct at the umbilical margin, but gradually disappearing near the periphery.

Size. Shell attaining a diameter of nearly 20 mm.

Form. & Loc. Upper Devonian: Adorf, Waldeck.

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[1] Abhandl. d. k.-k. geol. Reichsanst. vol. x. 1882, p. 183.

The following specimens do not exhibit the suture-line, and are therefore referred with some doubt to this species. Both were presented by John Edward Lee, Esq., 1885.

C. 2118 k. Small slab, containing amongst other specimens an example, 19 mm. in diameter, and a smaller somewhat imperfect specimen.

C. 2118 l. Lateral aspect of a specimen, 15 mm. in diameter, in matrix.

Gephyroceras intumescens (Beyrich).

[Fig. 25, *a*, *b*, *c*, p. 69.]

1832. *Goniatites compressus* (pars), G. Münster, Ueber Planul. u. Goniat. p. 33 (*fide* Gümbel).
1837. *Ammonites intumescens*, H. E. Beyrich, De Goniatitis in montibus rhenanis occurrentibus, p. 11, pl. ii. ff. 3 *a*, *b*, *c*; and Beitr. Kenntn. Verst. Rhein. Uebergangsgeb. p. 36, pl. ii. ff. 3 *a*, *b*, *c*.
1842. *Goniatites discors*, A. Sedgwick & R. I. Murchison, Trans. Geol. Soc. [2] vol. vi. p. 289 (*fide* Clarke).
1842. *Goniatites Buchii* (pars), d'Archiac & E. de Verneuil, Trans. Geol. Soc. [2] vol. vi. p. 340, pl. xxvi. f. 1 (*non* f. 2).
1843. *Goniatites intumescens*, F. A. Roemer, Verstein. Harzgeb. p. 33, pl. ix. ff. 8, 9, 15.
1843. *Goniatites Wurmii*, F. A. Roemer, ibid. p. 33, pl. ix. f. 7.
1844. *Goniatites Wurmii*, A. v. Keyserling, Verhandl. russ.-kais. mineral. Gesell. p. 237, pl. B. f. 2 (named *Goniatites Ammon* in explanation of plate).
1846. *Goniatites Ammon* (pars), A. v. Keyserling, Petschora-Land, p. 283, pl. xiii. f. 2 (*non* pl. xii. f. 1).
1846–49. *Goniatites Hœningshausi* (pars), F. A. Quenstedt, Petrefact. Deutschlands, p. 66, pl. iii. f. 5 (*non* v. Buch).
1850. *Aganides intumescens*, A. d'Orbigny, Prod. de Paléont. stratigr. vol. i. p. 59.
1850–6. *Goniatites intumescens*, var. *acutus*, *intermedius*, and *convexus*, G. & F. Sandberger, Verstein. rhein. Schichtensyst. Nassau, p. 82, pl. vii. ff. 1, 1 *a–c*, 2, 2 *a–g*, 3, 3 *a–c*, p. 56, ff. 2, 3.
1850–6. *Goniatites carinatus*, G. & F. Sandberger, ibid. p. 88, pl. vi. f. 4, pl. ix. f. 1 (*non* Beyrich).
1850–6. *Goniatites lamed*, var. *rugosus*, G. & F. Sandberger, ibid. p. 90, pl. viii. ff. 4, 4 *a–e*.
1851. *Goniatites intumescens*, and var. *acutus*, G. Sandberger, Jahrb. Nassau Ver. Nat. vol. vii. pts. 2 & 3, pp. 298, 303, pl. ii. f. 16, pl. iii. f. 34.
1851–6. *Goniatites intumescens*, F. Roemer in H. G. Bronn, Lethæa Geogn. vol. i. pt. 2, p. 517, pl. i[1]. f. 15.

? 1860. *Goniatites Patersoni*, J. Hall, Thirteenth Ann. Rep. New York State Cab. Nat. Hist. p. 99, ff. 9, 10.

1862. *Goniatites intumescens*, C. W. Gümbel, Neues Jahrb. p. 324, pl. v. f. 36 [1].

1879. *Goniatites intumescens*, F. Roemer, Zeitschr. deutsch. geol. Gesell. vol. xxxi. p. 659.

? 1879. *Goniatites Patersoni*, J. Hall, Palæont. N. York, vol. v. pt. 2, p. 464, pl. lxxii. ff. 1-5, pl. lxxiv. f. 15.

1880. *Goniatites intumescens*, W. Branco, Palæontogr. vol. xxvii. pl. vi. ff. 4 *a–d*.

1880. *Goniatites intumescens*, J. Gosselet, Esquisse géol. du Nord de la France, fasc. i. pl. iv. f. 14.

1880. *Goniatites intumescens*, F. Roemer, Geol. Mag. [2] vol. vii. p. 145.

1881. *Goniatites intumescens*, G. Dewalque, Ann. Soc. géol. Belgique, vol. viii. p. cxlv.

1882. *Goniatites intumescens*, E. Kayser, Zeitschr. deutsch. geol. Gesell. vol. xxxiv. p. 819.

1882. *Goniatites intumescens*, E. Holzapfel, Palæontogr. vol. xxviii. p. 242, pl. xlvi. (iii.) f. 2.

1882. *Goniatites primordialis*, E. Holzapfel, ibid. vol. xxviii. p. 241.

1882. *Goniatites carinatus* (pars), E. Holzapfel, ibid. vol. xxviii. p. 242.

1883. *Goniatites intumescens*, A. von Koenen, Neues Jahrb. ii. p. 170.

1884. *Goniatites intumescens*, J. M. Clarke, Neues Jahrb. Suppl. vol. iii. p. 325.

1884. *Manticoceras intumescens*, A. Hyatt, Proc. Boston Soc. Nat. Hist. vol. xxii. p. 318.

1884. *Goniatites intumescens*, Th. Tschernyschew, Mém. Com. géol. St. Pétersbourg, vol. i. no. 3, p. 2, woodc. f. 1, pl. i. f. 1.

1884. *Gephyroceras intumescens*, K. A. von Zittel, Handb. d. Palæont. vol. ii. p. 418.

1885. *Goniatites intumescens*, H. Woodward, Geol. Mag. [3] vol. ii. p. 345, pl. ix. ff. 1, 2.

1887. *Goniatites* (*Gephyroceras*) *intumescens*, F. Frech, Zeitschr. deutsch. geol. Gesell. vol. xxxix. p. 428.

1887. *Goniatites* (*Manticoceras*) *intumescens*, Th. Tschernyschew, Mém. Com. géol. St. Pétersbourg, vol. iii. no. 3, p. 19, pl. ii. ff. 3, 5.

1889. *Goniatites intumescens*, E. Kayser, Neues Jahrb. vol. i. p. 184.

1890. *Manticoceras intumescens*, G. Steinmann & L. Döderlein, Elem. d. Paläont. p. 396, woodc. f. 478.

1891. *Goniatites intumescens* (= *Goniatites Patersoni*), J. M. Clarke, Amer. Geol. vol. viii. p. 93.

Sp. Char. Shell very variable, sometimes rather tumid, some-

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[1] This figure is stated to be the "lobe-line of the original of *G. intumescens*, Beyr. (restored)"; it differs somewhat from the figure of the suture-line given by Beyrich (*l. c.* f. 3 *a*).

times flattened and the periphery rounded, sometimes lenticular and the periphery acute; greatest width near the umbilicus, variable, from four-sevenths of the diameter in the tumid form to two-sevenths of the diameter in the lenticular form; height of outer whorl about one-half of the diameter of the shell. Whorls five or six; inclusion two-thirds to three-fourths; umbilicus usually small, more rarely rather wide. Whorl semi-elliptical or cordate in section, a little higher than wide, sometimes sagittate in section and much higher than wide; indented by preceding whorl to about one-fifth of its height in forms with a convex periphery, and to about two-sevenths of its height in forms with an acute periphery; periphery broadly rounded to acute; sides more or less convex or flattened; inner area convex, the portion adjoining the suture nearly at right angles to the plane of symmetry. Chambers rather shallow; suture-line as in fig. 25 *c*, p. 69. Test thick, thinner in the form with acute periphery, almost smooth, with simple delicate lines of growth, strongly curved on the lateral area, their convexity being directed forward, and forming on the periphery a wide sinus having its concavity directed forward. "Wrinkle-layer" composed of fine irregularly-undulating rugæ, overlaying broad, usually indistinct, transverse, falciform bands.

Size. Shell attaining a diameter of more than 250 mm.

Form. & Loc. Upper Devonian: Lower Dunscombe, near Chudleigh, S. Devon; Adorf, Waldeck; Oberscheld, near Dillenburg, and Bicken, near Herborn, Nassau; N.W. Hartz; Belgium.

(i.) *Lower Dunscombe, near Chudleigh, S. Devon.*

The following specimens were presented by John Edward Lee, Esq., 1885, unless otherwise stated:—

C. 299. Four compressed and more or less imperfect examples, the largest being 98 mm. in diameter.

C. 299 a. One moiety of a bisected specimen, 195 mm. in diameter, polished.

C. 458. Thirteen compressed and more or less imperfect examples, ranging from 36 to 91 mm. in diameter.

Presented by A. Champernowne, Esq., 1883.

C. 603. Eighteen similar specimens, ranging from 29 to 129 mm. in diameter.

C. 604. One fine example, 160 mm. in diameter, exhibiting a portion of the test in the neighbourhood of the umbilicus.

C. 1832. One very large and fairly well-preserved specimen, 255 mm. in diameter. A portion of one side of the specimen has been ground away so as to display the suture-line.

C. 1833. Two elliptical, somewhat compressed examples, each about 200 mm. in its longest diameter.

C. 1834. Seventy-five specimens, ranging from 20 to 145 mm. in diameter, the majority crushed and some in matrix. The suture-line is well shown in several examples.

C. 1834 a. A compressed example, 58 mm. in diameter, polished on one side.

C. 1834 b. One moiety of a bisected specimen, 100 mm. in diameter, polished.

C. 1834 c. Portion of specimen, 34 mm. in diameter, in matrix, transversely sectioned and polished; some of the suture-lines are seen on the surface of the cast.

C. 1834 d. Crushed example, 35 mm. in diameter, with acute periphery, probably referable to this species.

C. 1837. Five ground and polished specimens, ranging from 20–54 mm. in diameter; (?) Lower Dunscombe.

C. 1954. Forty-three examples, ranging from 16 to about 85 mm. in diameter, the majority compressed and very imperfect.

C. 1954 a. A fragment of the septate portion, disclosing an inner whorl with the suture-line visible on its periphery.

C. 1956. Three compressed examples, each polished on one side.

C. 1956 a. A bisected compressed specimen, 95 mm. in diameter, one moiety polished.

C. 1956 b. A similar but smaller specimen.

C. 1956 c. One moiety of a compressed example, about 45 mm. in diameter.

C. 1956 d. One moiety of a larger specimen.

C. 1956 e. Two abraded specimens, each partly polished on one side.

C. 1957. Six specimens, more or less imperfect, ranging from 45 to 177 mm. in diameter.

C. 1957 a. A fragment probably referable to this species.

C. 1968. Six very imperfect examples, the largest being 45 mm. in diameter.

(ii.) *Nassau.*

47648. An imperfect specimen, 28 mm. in diameter; and an example, 16 mm. in diameter, showing the test, probably belonging to this species; Dillenburg.
Paul Mohr Collection.

62520. Two imperfect specimens, 32 and 50 mm. in diameter respectively; Oberscheld. *Purchased*, 1868.

75135. An imperfect example, 43 mm. in diameter; Dillenburg.
Toulmin-Smith Collection.

75138. Lateral aspect of example, 49 mm. in diameter, showing "wrinkle-layer" and test; Oberscheld.
Toulmin-Smith Collection.

75139. Portion of a specimen, about 30 mm. in diameter, in matrix, somewhat doubtfully referable to this species. The cast of the body-chamber, from which a portion of the test has been removed, bears a faint median keel. Oberscheld.
Toulmin-Smith Collection.

75140 and **75140 a.** One example, 23 mm. in diameter, partly buried in matrix; and an example, 23 mm. in diameter, in matrix, probably referable to this species; Oberscheld.
Toulmin-Smith Collection.

C. 1777. A specimen, 36 mm. in diameter, seen in section on abraded surface of matrix, probably referable to this species; Oberscheld. *Presented by John Edward Lee, Esq.*, 1885.

C. 1781. Two specimens, each about 38 mm. in diameter, one in matrix; Oberscheld.
Presented by John Edward Lee, Esq., 1885.

C. 2680 a. One example, 37 mm. in diameter, showing on one side the sculpture of the shell and on the other the suture-lines; Oberscheld. *Purchased*, 1889.

C. 4413 a–d. Four more or less imperfect specimens, ranging from 22 to 43 mm. in diameter; Oberscheld. The largest specimen (*d*) shows the angular form of the lateral lobe to commence at a point where the radius of the shell is 14 mm., *i. e.* where the height of the whorl is 11·5 mm.;

whilst another specimen (*b*), 29 mm. in diameter, has the lateral lobe somewhat angular at a point where the radius is 10 mm., *i. e.* where the height of the whorl is 7·5 mm. Presented to the Museum of Practical Geology by Dr. Sandberger. *Transferred from Mus. Pract. Geol.*

C. 4414. An example of the keeled variety, 29 mm. in diameter; Oberscheld. *Transferred from Mus. Pract. Geol.*

C. 4415, C. 4416. An imperfect specimen and a fragment in matrix; and a slab containing a number of small specimens, the largest about 23 mm. in diameter; Oberscheld.
Transferred from Mus. Pract. Geol

C. 4417. Two specimens, 37 and 18 mm. in diameter respectively, the smaller very much crushed; Oberscheld.
History unknown.

C. 4421. Distorted example, 38 mm. in diameter; Oberscheld.
Transferred from Mus. Pract. Geol.

C. 4423, C. 4424. Portion of a specimen, 32 mm. in diameter, showing sculpture of test; also portion of body-chamber showing sculpture on periphery; Oberscheld.
History unknown.

C. 4425. Imperfect specimen, 37 mm. in diameter, in matrix, showing sculpture of test; Oberscheld.
Transferred from Mus. Pract. Geol.

C. 4427. Fragment of a body-chamber, bearing portion of test, probably referable to this species.
Transferred from Mus. Pract. Geol.

C. 4429, C. 4431. Part of a specimen, about 30 mm. in diameter, in matrix; and an imperfect example, 25 mm. in diameter, partly buried in matrix; probably belonging to this species. Oberscheld. *Transferred from Mus. Pract. Geol.*

C. 4430. An imperfect specimen, 33 mm. in diameter, in matrix, doubtfully referable to this species; Eibach, near Dillenburg. *Transferred from Mus. Pract. Geol.*

(iii.) *Adorf, Waldeck.*

All the specimens were presented by John Edward Lee, Esq., 1885.

C. 1784. An imperfect cast, 56 mm. in diameter, partly buried in matrix.

C. 1842. A somewhat distorted example, 127 mm. in diameter; and five examples, ranging from 26 to 54 mm. in diameter.

C. 2118. Six examples, ranging from 15 to 37 mm. in diameter.

C. 2118 a. Two inflated examples, 15 and 17 mm. in diameter respectively, probably referable to this species. A portion of the suture-line is seen on the smaller specimen.

(iv.) *Bicken, near Herborn, Nassau.*

C. 591. One example, 72 mm. in diameter, showing a portion of the aptychus on the surface of the cast of the body-chamber. *Purchased*, 1884.

C. 650. An imperfect specimen, 47 mm. in diameter, having the aptychus *in situ*, figured in Geol. Mag. [3] vol. ii. 1885, pl. ix. figs. 1, 2. *Purchased*, 1884.

C. 4428. Two examples, 60 and 70 mm. in diameter respectively. *Purchased.*

(v.) *N.W. Hartz.*

C. 4418. Three specimens, 35, 38, and 61 mm. in diameter respectively, the smallest example exhibiting a portion of the test; Iberg, near Grund. *History unknown.*

C. 4419. One example, 32 mm. in diameter, having approximate septa; Iberg, near Grund. *History unknown.*

C. 4420 a–f. Six specimens, ranging from 17 to 43 mm. in diameter; Grund. The suture-line is shown in only one of these examples (C. 4420 *e*), and only at a point where the shell has a diameter of 31 mm.; the lateral lobe is decidedly angular. *History unknown.*

C. 4606. One example, 18 mm. in diameter; Ohnemannsbrink. *History unknown.*

C. 4622. Two specimens, 31 and 19 mm. in diameter respectively, doubtfully referable to this species; Altenau, Hartz. *Transferred from Mus. Pract. Geol.*

(vi.) *Belgium.*

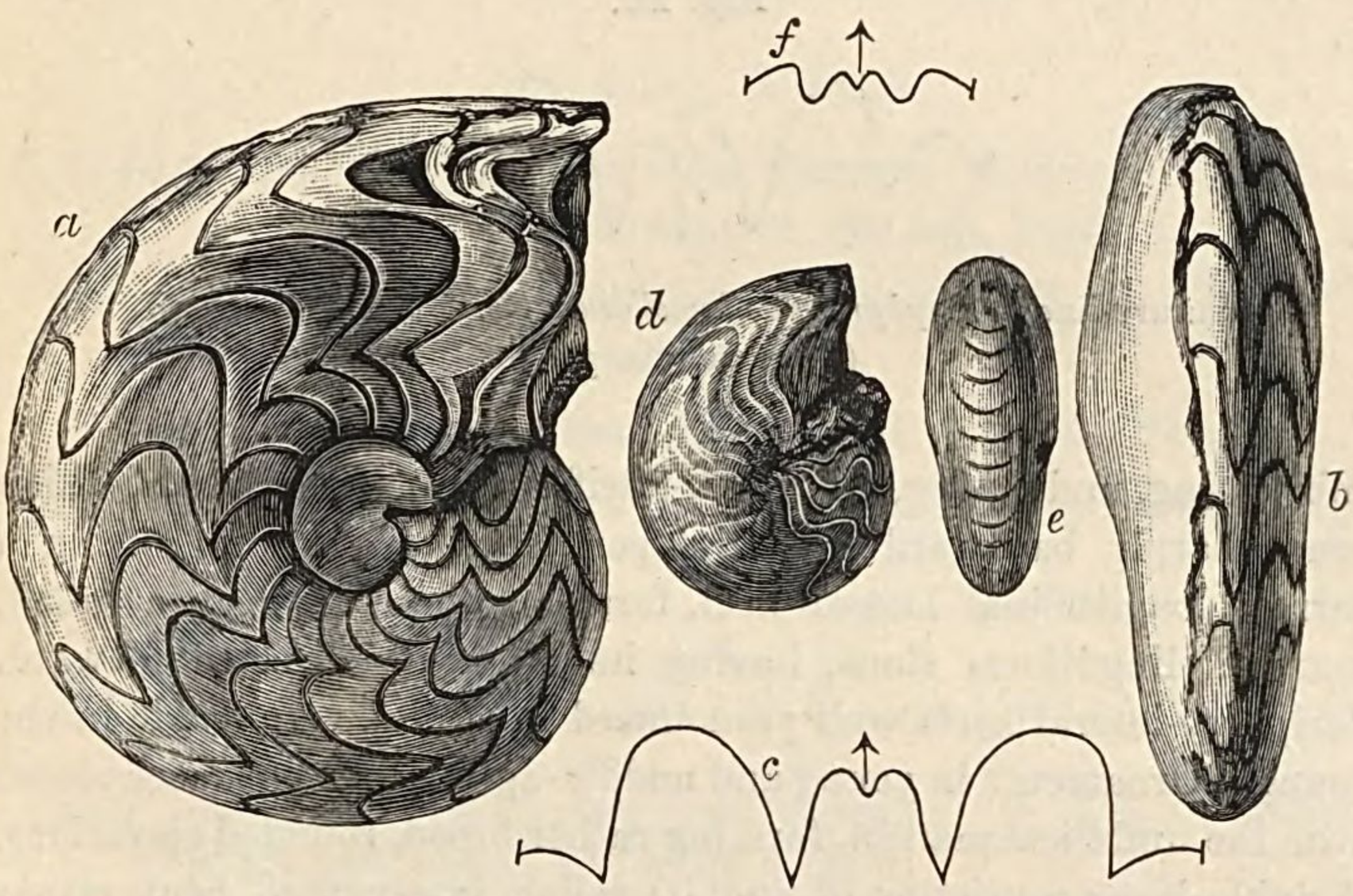
32816. A well-preserved example, 90 mm. in diameter, entirely septate; Frasnes. Shown of about one-half the natural size in fig. 25 *a*, *b*, *c*. *Purchased*, 1853.

36114. A crushed, imperfect specimen, 166 mm. in diameter, showing the body-chamber and a portion of the septate part; Nismes. *Purchased*, 1856.

C. 4422. A similar specimen, 162 mm. in diameter.
Transferred from Mus. Pract. Geol.

36115. Portion of a smaller specimen; Nismes.
Purchased, 1856.

Fig. 25.



a, *Gephyroceras intumescens* (Beyrich), lateral view of a natural cast (32816) from the Upper Devonian, Frasnes, Belgium; about one-half nat. size: *b*, peripheral view of the same specimen: *c*, suture-line of the same specimen. *d*, *Tornoceras simplex* (v. Buch), lateral view of a natural cast (89185) from the Upper Devonian, Büdesheim, Eifel; nat. size: *e*, peripheral view of the same specimen: *f*, suture-line of the same species. *a* to *e* are drawn from specimens in the British Museum; *f* is copied (and reduced) from G. and F. Sandberger (Verstein. rhein. Schichtensyst. Nassau, 1850–56, pl. x. fig. 14, *c*).

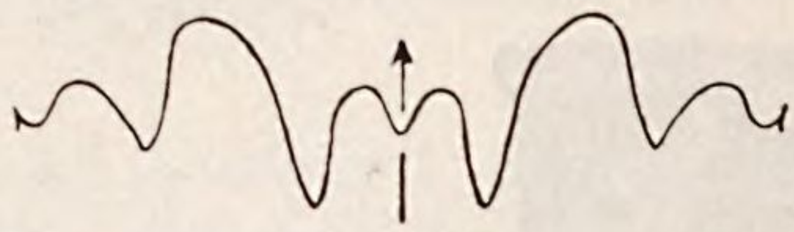
Gephyroceras lamellosum (G. & F. Sandberger).

1850–56. *Goniatites lamellosus*, G. & F. Sandberger, Verstein. rhein. Schichtensyst. Nassau, p. 85, pl. viii. ff. 1, 1 *a–e*.
1852. *Ammonites lamellosus* (pars), C. G. Giebel, Fauna der Vorwelt, vol. iii. p. 469.
1887. *Goniatites* (*Gephyroceras*) *lamellosus*, F. Frech, Zeitschr. deutsch. geol. Gesell. vol. xxxix. pp. 428, 433.

Sp. Char. Shell discoidal, flattened; greatest width at a short distance from the umbilicus, about two-sevenths of the diameter of

the shell; height of outer whorl about three-sevenths of the diameter. Whorls five to seven; inclusion about two-thirds; umbilicus wide, step-like. Section of whorl in adult specimens oval, higher than wide, in younger specimens relatively wider; indented to about one-fourth of its height by the preceding whorl; periphery convex, somewhat flattened; sides flattened, slightly convex; inner margin rounded. Chambers rather shallow; suture-line as in fig. 26. Test ornamented with forwardly-inclined,

Fig. 26.



Suture-line of *Gephyroceras lamellosum* (G. & F. Sandberger).
(After Sandberger.)

imbricating, undulating, somewhat falciform transverse bands, which bend sharply backward near the periphery, and after crossing a narrow longitudinal lateral keel, form on the periphery a broad, rounded, linguiform sinus, having its concavity directed forward. Periphero-lateral keels well pronounced in adults, very feeble in the young. Ornaments in young and middle-aged specimens fasciculated near the umbilical margin, forming rather broad, rounded elevations. Wrinkle-layer consisting of fine, irregular, interrupted, bent, rather distant rugæ.

Differs from *Geph. intumescens* (Beyrich) in the direction of its lines of growth and in the character of its suture-line.

Size. Shell attaining a diameter of more than 65 mm.

Form. & Loc. Upper Devonian: Oberscheld, near Dillenburg, Nassau; Adorf, Waldeck.

(i.) *Oberscheld, Nassau.*

C. 1776. Specimen, 25 mm. in diameter, in matrix, showing the "wrinkle-layer" and sculpture of the shell. The somewhat irregular lines constituting the former are seen to anastomose and curve rather abruptly backward in the region of the suture of the shell.

Presented by John Edward Lee, Esq., 1885.

C. 2680 b. Greater portion of a compressed shell, 58 mm. in diameter, showing the ornaments of the test. The lateral lobe as seen in the penultimate whorl is rounded as in *Geph. sub-*

lamellosum (G. & F. Sandberger), but the striæ of the test appear to be not so much curved as in that species.

Purchased, 1889.

C. 4426. Natural cast of portion of body-chamber, showing sculpture of test near the umbilicus, probably referable to this species. *Transferred from Mus. Pract. Geol.*

C. 4428 a. Cast of body-chamber of specimen, 63 mm. in diameter, partly buried in matrix, doubtfully referred to this species. *Transferred from Mus. Pract. Geol.*

(ii.) *Adorf, Waldeck.*

C. 1842 a. One example, 30 mm. in diameter, showing the suture-lines, and, on a fragment of the test, faint traces of the sculpture. *Presented by John Edward Lee, Esq.*, 1885.

Gephyroceras sublamellosum (G. & F. Sandberger).

1850–56. *Goniatites sublamellosus*, G. & F. Sandberger, Verstein. rhein. Schichtensyst. Nassau, p. 87, pl. vi. ff. 2, 2 *a–c*.

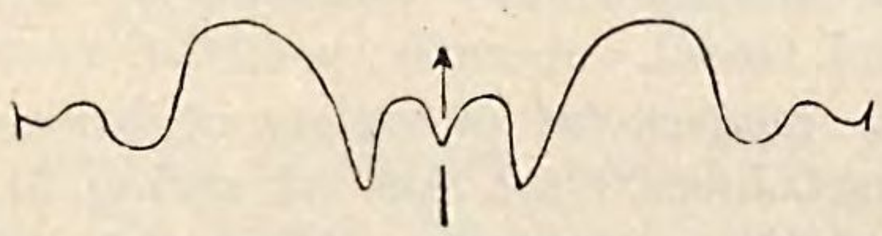
1851. *Goniatites sublamellosus*, G. Sandberger, Jahrb. Nassau Ver. Nat. vol. vii. pts. 2 & 3, p. 304, pl. iii. f. 29.

1852. *Ammonites lamellosus* (pars), C. G. Giebel, Fauna der Vorwelt, vol. iii. p. 469.

1887. *Goniatites* (*Gephyroceras*) *sublamellosus*, F. Frech, Zeitschr. deutsch. geol. Gesell. vol. xxxix. p. 433.

Sp. Char. Shell discoidal, flat; greatest thickness at a short distance from the umbilicus, about one-third of the diameter of the shell; height of outer whorl about two-fifths of the diameter. Whorls about six; inclusion about one-half; umbilicus rather wide, about one-fourth of the diameter of the shell. Whorl oval in section; indented to two-sevenths of its height by the preceding

Fig. 27.



Suture-line of *Gephyroceras sublamellosum* (G. & F. Sandberger).
(After Sandberger.)

whorl; periphery rather narrow, convex; sides feebly convex; inner margin rounded, sloping towards the umbilicus. Chambers rather deep, suture-line as in fig. 27. Test moderately thick, with

simple, waved, slightly-imbricating lines of growth or bands, which on the middle of the lateral area form a wide deep curve having its concavity directed forward, and on the periphery a short rounded sinus having its concavity directed forward. A feeble longitudinal keel on each side of the periphery. Initial chamber of medium size.

The ornaments form a deeper curve on the lateral area than in *Geph. lamellosum*, and the suture-lines of the two species differ slightly from each other.

Size. Shell attaining a diameter of about 35 mm.

Form. & Loc. Upper Devonian: Oberscheld and Eibach, near Dillenburg, Nassau.

C. 1776 a. Natural cast of body-chamber of specimen about 17 mm. in diameter, imbedded in matrix, doubtfully referred to this species. The very fine transverse slightly-backwardly directed striæ of the wrinkle-layer are displayed in the region of the periphery. Oberscheld.

Presented by John Edward Lee, Esq., 1885.

C. 1783. Two well-preserved examples, 29 and 34 mm. in diameter respectively, showing the sculpture of the test and the form of the suture-line; Oberscheld.

Presented by John Edward Lee, Esq., 1885.

C. 4603. One example, 10·5 mm. in diameter, in matrix, having one side well preserved and showing the sculpture of the test; Eibach. *Transferred from Mus. Pract. Geol.*

Gephyroceras complanatum (G. & F. Sandberger).

1850–56. *Goniatites lamed*, var. *complanatus*, G. & F. Sandberger, Verstein. rhein. Schichtensyst. Nassau, p. 90, pl. viii. ff. 5, 5 *a–d*.

1882. *Goniatites intumescens* (pars), E. Holzapfel, Palæontogr. vol. xxviii. p. 242.

1884. *Manticoceras complanatum*, A. Hyatt, Proc. Boston Soc. Nat. Hist. vol. xxii. p. 318.

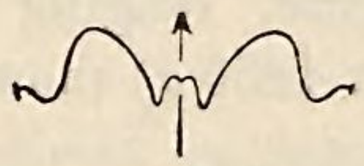
1887. *Goniatites* (*Gephyroceras*) *complanatus*, F. Frech, Zeitschr. deutsch. geol. Gesell. vol. xxxix. p. 428.

1890. *Goniatites complanatus* (a variety of *intumescens*), W. A. E. Ussher, Quart. Journ. Geol. Soc. vol. xlvi. p. 511.

[*Not* 1874. *Goniatites complanatus* (*Clymenia*? *complanata*, J. Hall, 1843), J. Hall, Descrip. New Species of Goniatidæ, p. 1.—1875. J. Hall, Twenty-seventh Rep. N. York State Mus. Nat. Hist. p. 132.—1879. J. Hall, Nat. Hist. N. York, pt. vi. Palæontology, vol. v. pt. 2, p. 455, pl. lxx. ff. 8–11.—1884. *Gephuroceras complanatum*, A. Hyatt, Proc. Boston Soc. Nat. Hist. vol. xxii. p. 317.]

Sp. Char. Shell discoidal, much compressed; greatest thickness close to the umbilical margin, about two-fifths of the diameter; height of outer whorl rather more than one-half of the diameter of the shell. Whorls about five; inclusion three-fourths; umbilicus narrow, shallow. Whorl cordate in section, compressed, higher than wide; indented to about one-fifth of its height by the preceding whorl; periphery narrowly convex; sides feebly convex, flattened; inner area convex, bevelled in casts. Body-chamber occupying half a whorl. Chambers very shallow; suture-line as in fig. 28. Test ornamented with fine regular transverse striæ, which

Fig. 28.



Suture-line of *Gephyroceras complanatum* (G. & F. Sandberger).
(After Sandberger.)

cross the lateral area in a slight curve having its concavity directed forward, and traverse the periphery in a rather deep sinus, having its concavity directed forward. Initial chamber small. Epidermids consisting of very fine transverse impressed interrupted wavy lines.

This species is closely allied to *Geph. orbiculus* (Beyrich), but is a more compressed shell with closer septa; the median saddle of its suture-line is proportionately higher, whilst the external saddle is more narrowly rounded.

Size. Shell attaining a diameter of 23 mm.

Form. & Loc. Upper Devonian: Büdesheim, Eifel; Saltern Cove, near Torquay, S. Devon.

(i.) *Büdesheim, Eifel.*

50170 b. An entirely septate specimen, 13 mm. in diameter, and an example, 11 mm. in diameter, having a portion of the body-chamber. *Morris Collection.*

89185 a. Two similar specimens, each 12·5 mm. in diameter, showing the initial chamber. In the entirely septate specimen the lateral lobe of the suture-line is seen to become distinctly angular. *Purchased*, 1877.

C. 1795 d. Nine examples, ranging from 8 to 15·5 mm. in diameter and three fragments.

Presented by John Edward Lee, Esq., 1885.

C. 1797. Three specimens, ranging from 12·5 to 14 mm. in diameter, and one example, 10·5 mm. in diameter, in matrix. In two of these specimens the lateral lobe is seen to become angular. *Presented by John Edward Lee, Esq.*, 1885.

C. 1798. Three examples, ranging from 9 to 14 mm. in diameter; and an imperfect larger specimen.
Presented by John Edward Lee, Esq., 1885.

C. 1811 b. Three specimens, ranging from 8 to 13 mm. in diameter. The largest is almost entirely septate, and the lateral lobe of the suture-line becomes decidedly angular.
Presented by John Edward Lee, Esq., 1885.

C. 4435 a–c. Three examples, ranging from 10 to 14 mm. in diameter; one (C. 4435 *a*) showing the initial chamber.
History unknown.

C. 4439. Three examples, ranging from 8·5 to 11 mm. in diameter.
History unknown.

The two following specimens may indicate another species; the later part of the outer whorl of each example bears straight forwardly-inclined ribs, extending nearly across the lateral area:—

89185 c. One example, 15 mm. in diameter, entirely septate.
Purchased, 1877.

C. 1795 e. Similar specimen, 12 mm. in diameter.
Presented by John Edward Lee, Esq., 1885.

(ii.) *Saltern Cove, near Torquay, S. Devon.*

C. 1961 b. Portion of a specimen, 8·5 mm. in diameter, and a fragment of a somewhat larger shell, probably referable to this species. *Presented by John Edward Lee, Esq.*, 1885.

The following specimens from the Eifel are referred to this species, but appear to form a link between this species and the next to be described, *Geph. orbiculus* (Beyrich):—

47655, 47660. Four examples, ranging from 7·5 to 17 mm. in diameter. *Paul Mohr Collection.*

52105. Four specimens, ranging from 11 to 13·5 mm. in diameter; Büdesheim. *Purchased*, 1867.

89185 b. Two examples, 12·5 and 20·5 mm. in diameter respectively. The body-chamber is preserved in the larger

specimens, and the lateral lobe of the last suture-line is not at all angular. Büdesheim. *Purchased*, 1877.

C. 1795 f, C. 1796, C. 1811. Three specimens, ranging in diameter from 10 to 13 mm.; and an imperfect example, 11·5 mm. in diameter; Büdesheim.

Presented by John Edward Lee, Esq., 1885.

C. 4436. One example, 20·5 mm. in diameter. The body-chamber is preserved, and the lateral lobe in each of the last two or three suture-lines is only very slightly angular; Büdesheim. *Purchased.*

C. 4437. Two specimens, 12 and 13 mm. in diameter respectively; Büdesheim. *Purchased.*

C. 4438. A somewhat inflated example, 12·5 mm. in diameter, having very approximate septa; Büdesheim.

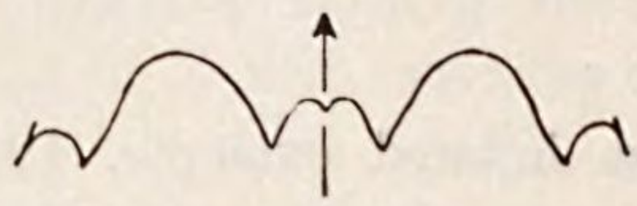
History unknown.

Gephyroceras orbiculus (Beyrich).

1837. *Ammonites orbiculus*, H. E. Beyrich, De Goniatitis in montibus rhenanis occurrentibus, p. 12, pl. ii. ff. 4 *a*, *b*.
1837. *Ammonites orbiculus*, E. Beyrich, Beitr. Kenntn. Verst. rhein. Uebergansgeb. p. 36, pl. ii. ff. 4 *a*, *b*.
1846–49. *Goniatites primordialis*, F. A. Quenstedt, Petrefact. Deutschlands, vol. i. (Cephalopoda), p. 67, pl. iii. f. 9.
1849. *Goniatites primordialis*, J. Steininger, Verstein. Uebergangsgeb. Eifel, p. 26.
1850. *Aganides orbiculus*, A. d'Orbigny, Prod. de Paléont. stratigr. vol. i. p. 60.
1850–56. *Goniatites lamed*, var. *cordatus*, G. & F. Sandberger, Verstein. rhein. Schichtensyst. Nassau, p. 90, pl. viii. ff. 6, 6 *a–k*.
1851. *Goniatites lamed*, var. *cordatus*, G. Sandberger, Jahrb. Nassau Ver. Nat. vol. vii. pts. 2 & 3, pp. 294, 298, pl. ii. fig. 3, pl. iii. f. 22.
1852. *Ammonites orbiculus*, C. G. Giebel, Fauna der Vorwelt, vol. iii. p. 464.
1853. *Goniatites primordialis*, J. Steininger, Geog. Besch. Eifel, p. 42.
1877. *Goniatites primordialis*, J. E. Lee, Geol. Mag. [2] vol. iv. p. 101, pl. v. f. 7.
1884. *Gephuroceras lamed*, var. *cordatus*, A. Hyatt, Proc. Boston Soc. Nat. Hist. vol. xxii. p. 316.
1884. *Manticoceras lamed*, A. Hyatt, ibid. vol. xxii. p. 318.
1884. *Goniatites orbiculus*, E. Beyrich, Zeitschr. deutsch. geol. Gesell. vol. xxxvi. p. 210.
1887. *Goniatites* (*Gephyroceras*) *orbiculus*, F. Frech, Zeitschr. deutsch. geol. Gesell. vol. xxxix. p. 429.

Sp. Char. Shell discoidal, somewhat inflated, almost involute; greatest thickness close to the umbilical margin, ranging from a little less to a little more than one-half of the diameter; height of outer whorl about one-half of the diameter of the shell. Whorls about five; inclusion almost complete; umbilicus small, in casts exposing the edges of the inner whorls. Whorl cordate in section; indented to about one-fourth of its height by the preceding whorl; periphery obtusely rounded; sides feebly convex, somewhat flattened in the middle of the lateral area; inner area convex, in casts sloping somewhat steeply towards the umbilicus. Body-chamber

Fig. 29.



Suture-line of *Gephyroceras orbiculus* (Beyrich).
(Copied from Beyrich, and completed.)

occupying half a whorl. Chambers shallow; suture-line as in fig. 29. Test ornamented with fine transverse striæ, which start from the suture, rise almost perpendicularly to the edge of the umbilicus, turn backward and form a curve having its concavity directed forward and extending over two-thirds of the width of the lateral area, then, turning backward, cross the periphery in a sinus having its concavity directed forward. Initial chamber moderately large, spherical. "Wrinkle-layer" composed of very fine transverse irregular wavy lines, directed backward in the neighbourhood of the umbilicus. Epidermids consisting of fine impressed wavy lines, which cross the sides obliquely, but pass straight over the periphery.

This species very much resembles *Geph. retrorsum* (v. Buch), but lacks the shallow grooves on either side of the periphery and has a finer sculpture. It is a more inflated shell than *Geph. complanatum*, G. & F. Sandberger.

Size. Shell attaining a diameter of 30 mm.

Form. & Loc. Upper Devonian: Oberscheld, near Dillenburg, Nassau; Adorf, Waldeck; Büdesheim, Eifel; Saltern Cove, near Torquay, S. Devon.

(i.) *Oberscheld, Nassau.*

C. 1780. One specimen, 14 mm. in diameter, showing sculpture of test. *Presented by John Edward Lee, Esq.*, 1885.

(ii.) *Adorf, Waldeck.*

C. 1846. Two specimens, about 15 and 10 mm. in diameter respectively, in matrix.

Presented by John Edward Lee, Esq., 1885.

C. 2118 f. One example, 17·5 mm. in diameter, showing the "wrinkle-layer."

Presented by John Edward Lee, Esq., 1885.

C. 2118 g. Four specimens, ranging in diameter from 8 to 12 mm.

Presented by John Edward Lee, Esq., 1885.

(iii.) *Büdesheim, Eifel.*

47649. Four examples, ranging from 7·5 to 12·5 mm. in diameter.

Paul Mohr Collection.

47656. Seven specimens, ranging from 7 to 17 mm. in diameter; Eifel (? Büdesheim). *Paul Mohr Collection.*

47660 a. Three examples, ranging from 8·5 to 10·5 mm. in diameter; Eifel (? Büdesheim). *Paul Mohr Collection.*

50170. Six specimens, ranging from 7 to 19 mm. in diameter; Eifel (? Büdesheim). *Morris Collection.*

50170 a. One example, 12·5 mm. in diameter, showing the initial chamber; Eifel (? Büdesheim). *Morris Collection.*

52105 a. Two imperfect examples, 11·5 and 13 mm. in diameter respectively. *Purchased*, 1867.

C. 1795 a. Twenty-seven examples, ranging from 4·5 to 15 mm. in diameter, and several fragments.

Presented by John Edward Lee, Esq., 1885.

C. 1795 b. Somewhat inflated and rather widely-umbilicated specimen, 17 mm. in diameter, and two fragments. The specimen is entirely septate, and in the last three septa the lateral lobe is angular.

Presented by John Edward Lee, Esq., 1885.

C. 1795 c. Nine examples, ranging from 5 to 8 mm. in diameter, showing the initial chamber.

Presented by John Edward Lee, Esq., 1885.

C. 1798 a. A rather crushed example, 14 mm. in diameter, partly buried in matrix.

Presented by John Edward Lee, Esq., 1885.

C. 1811 a, C. 2119. Ten specimens, ranging in diameter from 5·5 to 22 mm.; and a fragment.
Presented by John Edward Lee, Esq., 1885.

C. 4440, C. 4441. Fourteen specimens, ranging in diameter from 6 to 17 mm. *History unknown.*

C. 4442. Two examples, each 8 mm. in diameter. *Purchased.*

C. 4443. One specimen, 15 mm. in diameter.
Transferred from Mus. Pract. Geol.

(iv.) *Saltern Cove, near Torquay, S. Devon.*

C. 1753 a. Four fairly well-preserved examples, ranging in diameter from 7 to 10 mm., the largest specimen displaying the fine thread-like transverse epidermids.
Presented by John Edward Lee, Esq., 1885.

Gephyroceras retrorsum (v. Buch).

1832. *Ammonites retrorsus*, L. v. Buch, Phys. Abhandl. k. Akad. Wiss. Berlin, for 1830, p. 181, pl. ii. f. 13.
1842. *Goniatites retrorsus*, vars. *a*, *b*, d'Archiac & E. de Verneuil, Trans. Geol. Soc. [2] vol. vi. p. 338, pl. xxv. ff. 3–5 (*non* ff. 2, 2 *a–b*).
1850–56. *Goniatites lamed*, var. *tripartitus*, G. & F. Sandberger, Verstein. rhein. Schichtensyst. Nassau, p. 90, pl. viii. ff. 7, 7 *a–b*.
1872. *Goniatites retrorsus*, E. Kayser, Zeitschr. deutsch. geol. Gesell. vol. xxiv. p. 665.
1882. *Goniatites tripartitus*, E. Holzapfel, Palæontogr. vol. xxviii. p. 244 (*not* of Münster).
1884. *Manticoceras tripartitum*, A. Hyatt, Proc. Boston Soc. Nat. Hist. vol. xxii. pp. 317, 318.
1884. *Goniatites tripartitus*, J. M. Clarke, Neues Jahrb., Suppl. vol. iii. p. 328.
1884. *Goniatites lamed*, var. *tripartitus*, G. & F. Sandberger, =*Ammonites retrorsus*, v. Buch, E. Beyrich, Zeitschr. deutsch. geol. Gesell. vol. xxxvi. p. 216.
1884. *Goniatites retrorsus*, var. *b*, d'Archiac & de Verneuil, =*Ammonites retrorsus*, v. Buch, E. Beyrich, ibid. vol. xxxvi. p. 216.
[*Not* 1837. *Ammonites retrorsus*, H. E. Beyrich, De Goniatitis in montibus rhenanis occurrentibus, p. 6, pl. i. ff. 10 *a*, *b*, *c*; and Beitr. Kenntn. Verst. rhein. Uebergangsgeb. pt. i. p. 30, pl. i. ff. 10 *a*, *b*, *c*.—1850–56. *Goniatites retrorsus*, G. & F. Sandberger, Verstein. rhein. Schichtensyst. Nassau, p. 100; *et auct.*]

Sp. Char. Shell inflated, umbilicated; greatest thickness close to the umbilicus, about one-half of the diameter; height of outer whorl

nearly one-half of the diameter of the shell. Number of whorls (?); inclusion nearly complete; umbilicus not very small, exposing the edges of the inner whorls. Whorl cordate in section, about as wide as high, but sometimes wider than high, deeply indented by the preceding whorl; periphery more or less broadly convex, bounded by two shallow lateral channels, which are deeper in the young; sides feebly convex, somewhat flattened; inner margin nearly perpendicular to the plane of symmetry, slightly convex. Exact

Fig. 30.

Suture-line of *Gephyroceras retrorsum*? (v. Buch).
(Drawn from specimen No. C. 1967, and enlarged.)

length of body-chamber unknown. Chambers moderately shallow; suture-line (?) as in fig. 30. Test ornamented with fine regular striæ, which form on the inner two-thirds of the lateral area a curve having its concavity directed forward; then, turning somewhat abruptly backward at the lateral groove bounding the periphery, they form on the latter a deep sinus having its concavity directed forward.

Size. Shell attaining a diameter of about 18 mm.

Form. & Loc. Upper Devonian: Oberscheld, near Dillenburg, Nassau; Adorf, Waldeck; Saltern Cove, near Torquay, Devon.

75140 d. One example, 18 mm. in diameter, partly buried in matrix, showing sculpture of test; Oberscheld, Nassau.
Toulmin-Smith Collection.

C. 1780 a. Several fragments, imbedded in matrix, showing ornamentation of shell; Oberscheld, Nassau.
Presented by John Edward Lee, Esq., 1885.

C. 1967. Fairly well-preserved specimen, 7 mm. in diameter, doubtfully referable to this species. Nearly one-half of the outer whorl is occupied by body-chamber. The umbilicus is rather wide, and in this respect resembles the young of *Gephyroceras æquabile*. Saltern Cove, near Torquay.
Presented by John Edward Lee, Esq., 1885.

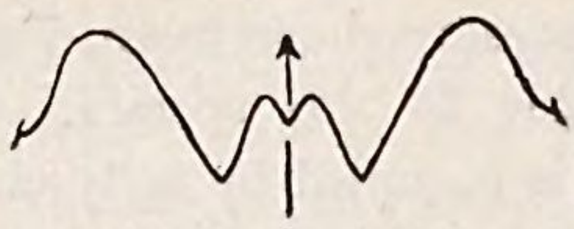
C. 2118 h. Five examples, ranging in diameter from 8 to 17 mm., some in matrix; Adorf, Waldeck.
Presented by John Edward Lee, Esq., 1885.

Gephyroceras bisulcatum (F. A. Roemer).

1842. *Goniatites retrorsus*, d'Archiac & E. de Verneuil, Trans. Geol. Soc. [2] vol. vi. p. 338, pl. xxv. ff. 2, 2 *a*, *b* (*non* ff. 3–5).
1850. *Goniatites bisulcatus*, F. A. Roemer, Palæontogr. vol. iii. p. 39, pl. vi. ff. 8 *a*, *b*, *c*; and Beitr. Geol. Kenntn. nordwestl. Harzgeb. i. p. 39, pl. vi. ff. 8 *a*, *b*, *c*.
1870. *Goniatites bisulcatus*, E. Tietze, Palæontogr. vol. xix. p. 132.
1880. *Goniatites bisulcatus*, W. Branco, ibid. vol. xxvii. pl. vi. f. 3.
1884. *Goniatites bisulcatus*, J. M. Clarke, Neues Jahrb., Suppl. vol. iii. p. 327.
1884. *Gephuroceras bisulcatum*, A. Hyatt, Proc. Boston Soc. Nat. Hist. vol. xxii. p. 317.
[*Not* 1832. *Ammonites retrorsus*, L. v. Buch, Phys. Abhandl. k. Akad. Wiss. Berlin, for 1830, p. 181, pl. ii. f. 13.—1837. *Ammonites retrorsus*, H. E. Beyrich, De Goniatitis in montibus rhenanis occurrentibus, p. 6, pl. i. ff. 10 *a*, *b*, *c*; and Beitr. Kenntn. Verst. rhein. Uebergangsgeb. pt. i. p. 30, pl. i. ff. 10 *a*, *b*, *c*.—1844. *Goniatites bisulcatus*, A. v. Keyserling, Verhandl. russ.-kais. mineral. Gesell. p. 235, pl. A. f. 7; and 1846, Petschora-Land, p. 282, pl. xii. f. 7.]

Sp. Char. Shell somewhat inflated; greatest thickness at the umbilical margin, about two-thirds of the diameter; height of outer whorl about three-sevenths of the diameter of the shell. Whorls five or six; inclusion five-sixths; umbilicus rather narrow, about two-sevenths of the diameter of the shell in width, with subangular border, deep, exposing the edges of the inner whorls. Whorl cordate in section, wider than high, indented to about one-third of its height by the preceding whorl; periphery rounded, bounded on either side by a shallow groove, which is relatively deeper in the young; sides not very convex, sloping from the umbilical margin to the periphery; inner area steep, almost perpendicular, convex. Body-chamber occupying nearly a whorl. Chambers not very deep, numerous; suture-line as in fig. 31 [1]. Test covered with fine regular

Fig. 31.



Suture-line of *Gephyroceras bisulcatum* (F. A. Roemer). (Copied from Roemer and completed.)

[1] Clarke (*l. c.* p. 328) states that the suture-line given by F. A. Roemer is not quite correct; the external saddle is too large and the half of the external (peripheral) lobe which he indicates is too small. They are both of about the same size and similarly rounded.

striæ, which start from the suture, rise almost perpendicularly to the edge of the umbilicus, then turn backward and form an arch, which has its concavity directed forward and extends over two-thirds of the lateral area, *i. e.* to the lateral groove, there the striæ form a curve whose convexity is directed backward, and then cross the periphery in a curve whose convexity is directed forward. Initial chamber rather large, globular, somewhat compressed.

This species is more inflated, and has a wider umbilicus than *Geph. retrorsum* (v. Buch) and *Geph. carinatum* (Beyrich); it has also a larger and more prominent keel than the latter.

Size. D'Archiac and de Verneuil (*l. c.*) figure an example 30 mm. in diameter.

Form. & Loc. Upper Devonian (Iberger-Kalk): Winterberg, N.W. Hartz.

C. 4604. Two well-preserved specimens, 20·5 and 26·5 mm. diameter respectively. *History unknown.*

Gephyroceras Koeneni (Holzapfel).

1882. *Goniatites Koeneni*, E. Holzapfel, Palæontogr. vol. xxviii. p. 244, pl. xlvi. (iii.), ff. 4, 4 *a–c*, 5, 6, 6 *a*.

Sp. Char. Shell discoidal, umbilicated, inflated in the young, more compressed in the adult; greatest thickness near the edge of the umbilicus, about two-fifths of the diameter; height of outer whorl rather more than one-half of the diameter of the shell. Whorls five or six; inclusion about one-third; umbilicus moderately wide, about one-fourth of the diameter of the shell, deep, with step-like sides. Whorl semilunate in section in the young, twice as wide as high, becoming cordate in the adult and much higher than wide; indented to about one-fourth of its height by the preceding whorl; periphery broadly rounded in the young, becoming acute in the adult; sides convex in the young, flattened in the adult; inner margin imperfectly defined, convex. Body-chamber

Fig. 32.

Suture-line of *Gephyroceras Koeneni*.
Copied from Holzapfel and completed.

occupying nearly a whorl. Depth of chambers (?); suture-line of the adult as in fig. 32. Test rather thick, ornamented with

numerous, sharp, prominent striæ which form a sinus having its concavity directed forward over two-thirds of the side, and then turning somewhat abruptly backward form on the periphery a deep sinus also having its concavity directed forward. Between these prominent striæ are finer, similarly-disposed lines. "Wrinkle-layer" composed of very fine, transverse, wavy, interrupted rugæ, which cross the sides somewhat obliquely and turn backwards at the suture.

Near *Gephyroceras retrorsum* (v. Buch), but distinguished by the ornaments of its test.

Size. Shell attaining a diameter of about 40 mm.

Form. & Loc. Upper Devonian: Adorf, Waldeck.

All the examples of this species in the Collection were presented by John Edward Lee, Esq., 1885.

C. 1844. Distorted specimen, in matrix, 13·5 mm. in diameter, showing the sculpture of the test.

C. 2118 i. Two examples, 17·5 and 18 mm. in diameter respectively, the larger showing the "wrinkle-layer;" also a very imperfect specimen, 13·5 mm. in diameter, probably referable to this species.

Gephyroceras affine (Steininger).

1832. *Ammonites primordialis* (pars), L. v. Buch, Phys. Abhandl. k. Akad. Wiss. Berlin, for 1830, p. 168, pl. i. ff. 15, 16, 17 (*non* Schlotheim).

1849. *Goniatites affinis*, J. Steininger, Verstein. Uebergangsgeb. Eifel, p. 26.

1850–56. *Goniatites lamed*, var. *latidorsalis*, G. & F. Sandberger, Verstein. rhein. Schichtensyst. Nassau, p. 90, pl. viii. ff. 8, 8 *a*, *b*.

1851. *Goniatites lamed*, var. *latidorsalis*, G. Sandberger, Jahrb. Nassau Ver. Nat. vol. vii. pts. 2 & 3, p. 304, pl. iii. f. 30.

1853. *Goniatites affinis*, J. Steininger, Geogn. Beschreib. Eifel, p. 42, pl. i. ff. 4, 4 *a*.

1882. *Goniatites affinis*, E. Holzapfel, Palæontogr. vol. xxviii. p. 243, pl. xlvi. (iii.) ff. 3, 3 *a*, *b*.

1884. *Manticoceras latidorsatum*, A. Hyatt, Proc. Boston Soc. Nat. Hist. vol. xxii. p. 318.

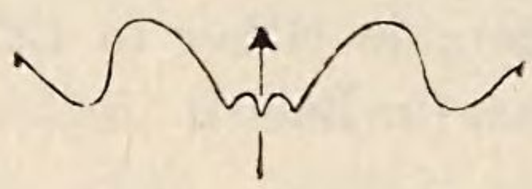
1884. *Goniatites affinis*, E. Beyrich, Zeitschr. deutsch. geol. Gesell. vol. xxxvi. p. 208.

1887. *Goniatites* (*Gephyroceras*) *affinis*, F. Frech, Zeitschr. deutsch. geol. Gesell. vol. xxxix. pp. 377, 428.

Sp. Char. Shell discoidal, inflated; greatest thickness close to the edge of the umbilicus, in adults nearly one-half and in the young more than one-half of the diameter; height of outer whorl

in adults about one-half, and in the young much less than one-half of the diameter of the shell. Whorls four or five; inclusion one-half; umbilicus deep, not very wide in the adult, about one-fourth of the diameter of the shell, relatively wider in the young, exposing the edges of the inner whorls. Whorl obtusely cordate in section, wider than high; more depressed and relatively wider in the young; not much indented by the preceding whorl; periphery broadly convex, flattened in the young, sides convex; inner area convex, sloping; in the young the lateral angle of the whorl forms a subangular edge around the umbilicus. Body-chamber occupying about half a whorl. Chambers rather deep; suture-line as in fig. 33. Test ornamented with transverse striæ, which, passing

Fig. 33.



Suture-line of *Gephyroceras affine* (Steininger).
Copied from Holzapfel and completed.

from the umbilicus, form first a slight curve having its concavity directed forward and extending to the middle of the lateral area, then curve backward and cross the periphery in a wide shallow sinus having its concavity directed forward. Initial chamber rather large, spheroidal. Epidermids consisting of very fine, impressed, transverse, wavy lines.

Size. Shell attaining a diameter of more than 25 mm.

Form. & Loc. Upper Devonian: Büdesheim, Eifel; (? Saltern Cove, near Torquay, S. Devon).

Unless otherwise stated, the specimens were presented by John Edward Lee, Esq., 1885.

(i.) *Büdesheim, Eifel.*

C. 1790 a. Natural cast, 23·5 mm. in diameter, nearly one-half of the outer whorl consisting of the body-chamber. The lateral lobe of the last septum is rounded.

C. 1790. A similar specimen, of about the same size as the preceding, but entirely septate, showing the very fine epidermids. The lateral lobe is distinctly angular in each of the last six septa.

C. 1795 g. Two examples, 3·5 and 6·5 mm. in diameter respectively, the smaller showing the initial chamber.

C. 4479. Two specimens, 5·5 and 10 mm. in diameter respectively. *History unknown.*

(ii.) *Saltern Cove, near Torquay.*

C. 1753 b, c. Portion of whorl, 4 mm. in diameter, in matrix, showing the suture-line; and an imperfect more inflated specimen, 6 mm. in diameter, doubtfully referable to this species.

C. 1960. Three fairly well-preserved specimens, in matrix, ranging in diameter from 5·5 to 8 mm., referable either to this species or to *Gephyroceras retrorsum* (v. Buch). The medium-sized specimen shows the epidermids.

C. 1961. Part of septate portion of whorl, about 10 mm. in diameter, distorted, referable either to this species or to *Gephyroceras retrorsum* (v. Buch).

C. 1961 a. Distorted fragmentary specimen, about 8 mm. in diameter, referable either to this species or to *Gephyroceras Koeneni* (Holzapfel).

C. 1967 a. Imperfect specimen, 6 mm. in diameter, probably referable to this species.

Gephyroceras calculiforme (Beyrich).

1837. *Ammonites calculiformis*, H. E. Beyrich, De Goniatitis in montibus rhenanis occurrentibus, p. 12, pl. ii. ff. 5 *a, b, c*; and Beitr. Kenntn. Verst. rhein. Uebergangsgeb. p. 37, pl. ii. ff. 5 *a, b, c*.

1842. *Goniatites calculiformis*, d'Archiac & de Verneuil, Trans. Geol. Soc. [2] vol. vi. p. 342.

1843. *Goniatites calculiformis*, F. A. Roemer, Verstein. Harzgeb. p. 34, pl. ix. ff. 14 *a, b, c*.

1849. *Goniatites Gerolsteinensis*, J. Steininger, Verstein. Uebergangsgeb. Eifel, p. 27.

1850–56. *Goniatites lamed*, var. *calculiformis*, G. & F. Sandberger, Verstein. rhein. Schichtensyst. Nassau, p. 90, pl. viii. ff. 9, 9 *a, b* (*not* ff. 9 *c, d*; *fide* Hyatt).

1850. *Aganides calculiformis*, A. d'Orbigny, Prod. de Paléont. stratigr. vol. i. p. 58.

1851. *Goniatites lamed*, var. *calculiformis*, G. Sandberger, Jahrb. Nassau Ver. Nat. vol. vii. pts. 2 & 3, p. 304, pl. iii. f. 31.

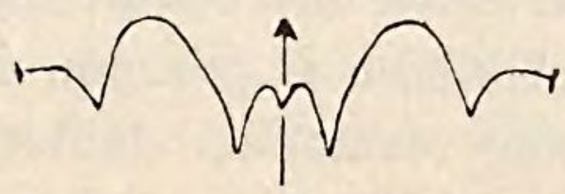
1852. *Ammonites primordialis* (pars), C. G. Giebel, Fauna der Vorwelt, vol. iii. (Mollusca), p. 466.

1853. *Goniatites Gerolsteinensis*, J. Steininger, Geogn. Beschreib. Eifel, p. 43, pl. i. ff. 8, 8 *a*.

1867. *Goniatites quadratus*, W. Trenkner, Paläont. Novit. i. p. 6, pl. i. ff. 8 *a*, *b*.
1867. *Bellerophon discoides*, W. Trenkner, ibid. i. p. 8, pl. i. ff. 13 *a*, *b* (*fide* J. M. Clarke).
1877. *Goniatites Gerolsteinus*[*-ensis*], J. E. Lee, Geol. Mag. [2] vol. iv. p. 101, pl. v. f. 8.
1880. *Goniatites lamed*, var. *calculiformis*, W. Branco, Palæontogr. vol. xxvii. pl. vi. f. 1; pl. x. f. 5.
1882. *Goniatites calculiformis*, E. Holzapfel, Palæontogr. vol. xxviii. p. 245, pl. xlvi. (iii.) ff. 11–15.
1884. *Goniatites calculiformis*, J. M. Clarke, Neues Jahrb., Suppl. vol. iii. p. 329.
1884. *Gephuroceras calculiforme*, A. Hyatt, Proc. Boston. Soc. Nat. Hist. vol. xxii. p. 317.
1887. *Goniatites* (*Gephyroceras*) *calculiformis*, F. Frech, Zeitschr. deutsch. geol. Gesell. vol. xxxix. pp. 377, 428.

Sp. Char. Shell discoidal, flattened, evolute in the young but becoming involute in the adult; position and relative proportion of the greatest thickness variable with the age of the shell; height of outer whorl about two-fifths of the diameter of the shell. Whorls seven or eight, slowly increasing; no inclusion in the young, in the adult two-thirds; umbilicus very wide and shallow in the young, becoming relatively narrower and deeper as the shell increases in size, about one-third of the diameter of the shell in width in the adult. Shape of section of whorls variable with the age of the shell, successively oval, obtusely cordate, with the greatest width at the periphery, reniform, subquadrate, almost circular, and subsequently subtriangular, much higher than wide, with its greatest width at the edge of the umbilicus; amount of indentation small; periphery convex in the young and adult, somewhat concave and relatively broader in the intermediate stages; sides more or less

Fig. 34.



Suture-line of *Gephyroceras calculiforme* (Beyrich), enlarged.
After Sandberger.

convex, varying with the age of the shell; inner area not defined on the inner whorls, on the outer whorl imperfectly defined, convex. Length of body-chamber (?) Chambers numerous, not particularly deep; suture-line as in fig. 34. Test ornamented with sometimes coarse, sometimes fine, sigmoidal lines of growth, which become

imbricating in adult specimens. Initial chamber not very large, globular, somewhat compressed.

Differs from *Geph. lamellosum* (G. & F. Sandberger) in its wider umbilicus, in its slower rate of increase, and chiefly in the absence of the longitudinal band on either side of the periphery; from *Geph. sublamellosum* (G. & F. Sandberger) it differs in its much slower rate of increase and in the character of its suture-line.

Size. Holzapfel (*l. c.* pl. xlvi. (iii.) fig. 14) figures an example 44 mm. in diameter.

Form. & Loc. Upper Devonian: Oberscheld, near Dillenburg, Nassau; Adorf, Waldeck; Büdesheim, Eifel; Ohnemannsbrink, N.W. Hartz.

75136. Lateral aspect of example, 13 mm. in diameter, in matrix, showing sculpture of shell; Oberscheld.

Toulmin-Smith Collection.

75137. Lateral aspect of imperfect specimen, about 11 mm. in diameter, in matrix; Oberscheld.

Toulmin-Smith Collection.

75140 c. Lateral aspect of a specimen rather more than 12 mm. in diameter, on surface of slab; Oberscheld.

Toulmin-Smith Collection.

C. 1773. Slab, in counterpart, exhibiting two small imperfect specimens; Oberscheld.

Presented by John Edward Lee, Esq., 1885.

C. 1795. Imperfect specimen, 10 mm. in diameter, showing somewhat indistinctly the course of the suture-line; Büdesheim. *Presented by John Edward Lee, Esq.*, 1885.

C. 2118 d, e. Two small slabs, one containing three small examples the largest of which is 8·5 mm. in diameter; the other containing one example, doubtfully referable to this species, 7 mm. in diameter; Adorf, Waldeck.

Presented by John Edward Lee, Esq., 1885.

C. 2681. Lateral aspect of a portion of a small example, doubtfully referred to this species; Oberscheld.

Transferred from Museum of Practical Geology.

C. 4605. An imperfect specimen, 11 mm. in diameter, imbedded in matrix, consisting of the inner whorls up to a diameter of

7 mm., and of a portion of the outer whorl. The peripheral lobe of the suture-line is visible on one of the inner whorls. Ohnemannsbrink, N.W. Hartz.

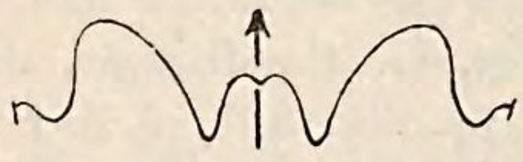
History unknown.

Gephyroceras æquabile (Beyrich).

1837. *Ammonites aequabilis*, H. E. Beyrich, De Goniatitis in montibus rhenanis occurrentibus, p. 10, pl. ii. ff. 1 *a*, *b*; and Beitr. Kenntn. Verst. rhein. Uebergangsgeb. p. 34, pl. ii. ff. 1 *a*, *b*.
1843. *Goniatites æquabilis*?, F. A. Roemer, Verstein. Harzgeb. p. 34, pl. ix. ff. 13 *a*, *b*.
1850. *Aganides æquabilis*, A. d'Orbigny, Prod. de Paléont. stratigr. vol. i. p. 59.
1850–56. *Goniatites aequabilis*, G. & F. Sandberger, Verstein. rhein. Schichtensyst. Nassau, p. 94, pl. viii. ff. 10, 10 *a–e*.
1850–56. *Goniatites lamed*, var. *calculiformis*, G. & F. Sandberger, ibid. p. 90, pl. viii. ff. 9 *c*, *d* (*not* 9, 9 *a*; *fide* Hyatt).
1851. *Goniatites aequabilis*, G. Sandberger, Jahrb. Nassau Ver. Nat. vol. vii. pts. 2 & 3, p. 294, pl. ii. f. 2.
1882. *Goniatites æquabilis*, E. Holzapfel, Palæontogr. vol. xxviii. p. 246.
1884. *Gephuroceras æquabile*, A. Hyatt, Proc. Boston Soc. Nat. Hist. vol. xxii. p. 317.
1887. *Goniatites* (*Gephyroceras*) *æquabilis*, F. Frech, Zeitschr. deutsch. geol. Gesell. vol. xxxix. p. 433.

Sp. Char. Shell discoidal, very flat; greatest thickness near the umbilical margin, from one-third (in the young) to one-fifth (in the adult) of the diameter of the shell; height of outer whorl about two-sevenths of the diameter of the shell. Whorls six; inclusion nearly one-half; umbilicus shallow, from one-third (in the young) to rather more than three-sevenths (in the adult) of the diameter of the shell in width. Whorl oval in section, higher than wide; indented to one-third or one-fourth of its height by the preceding whorl; periphery convex; sides somewhat flattened; inner margin rounded, sloping. Body-chamber occupying about three-fourths of a whorl. Chambers rather shallow; suture-line as in fig. 35.

Fig. 35.



Suture-line of *Gephyroceras æquabile* (Beyrich).
After Sandberger.

Test rather thick, almost smooth or ornamented with simple, curved

ribs and finer ones, which cross the whorls obliquely backward, forming on the lateral area a curve having its concavity directed forward, and on the periphery a sinus also with its concavity forward. Epidermids rather fine, almost straight, sometimes irregular on the peripheral area, rugose. Initial chamber round, compressed, of moderate size.

Size. Shell attaining a diameter of 55 mm.

Form. & Loc. Upper Devonian : Oberscheld, Nassau ; Adorf, Waldeck.

C. 2118 b, c. Two examples, 13 and 15 mm. in diameter respectively, one in matrix, the smaller showing the very fine sculpture of the shell ; Adorf.

Presented by John Edward Lee, Esq., 1885.

C. 4444. Lateral aspect of an imperfect specimen, 32·5 mm. in diameter, in matrix ; Oberscheld.

Transferred from Museum of Practical Geology.

C. 4445. Lateral aspect of specimen, 47 mm. in diameter, in matrix, showing epidermids at the base of the cast of the body-chamber, a portion of the suture-line, and also the sculpture of the test on the penultimate whorl. The specimen is labelled "Wissenbach," but its matrix agrees so well with that of the preceding specimen that there can be little doubt that it came from the same locality, viz., Oberscheld.

Transferred from Museum of Practical Geology.

Gephyroceras serratum (Steininger).

1842. *Goniatites Buchii*, var., d'Archiac & de Verneuil, Trans. Geol. Soc. [2] vol. vi. p. 340, pl. xxvi. ff. 2, 2 *a* (*not* f. 1).

1849. *Goniatites serratus*, J. Steininger, Verstein. Uebergangsgeb. Eifel, p. 27.

1850. *Goniatites dorsicosta*, F. A. Roemer, Palæontogr. vol. iii. p. 40, pl. vi. fig. 10; and Beitr. geol. Kenntn. nordwestl. Harzgeb. i. p. 40, pl. vi. f. 10.

1850–56. *Goniatites serratus*, G. & F. Sandberger, Verstein. rhein. Schichtensyst. Nassau, p. 95, pl. ix. ff. 8, 8 *a–g*.

1851. *Goniatites serratus*, G. Sandberger, Jahrb. Nassau Ver. Nat. vol. vii. pts. 2 & 3, pp. 296, 301, pl. ii. f. 7 ; pl. iii. f. 19.

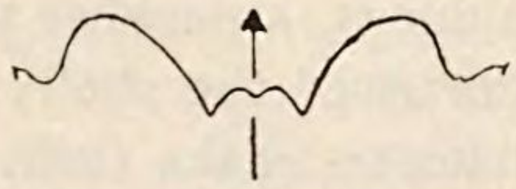
1852. *Ammonites serratus*, C. G. Giebel, Fauna der Vorwelt, vol. iii. (Mollusca), p. 464.

1853. *Goniatites serratus*, J. Steininger, Geogn. Beschreib. Eifel, p. 43, pl. i. ff. 10, 10 *a*.

1871. *Goniatites Buchii*, E. Kayser, Zeitschr. deutsch. geol. Gesell. vol. xxiii. p. 354.
1880. *Goniatites serratus*, W. Branco, Palæontogr. vol. xxvii. pl. vi. f. 2.
1882. *Goniatites Buchii*, E. Holzapfel, Palæontogr. vol. xxviii. p. 243.
1884. *Gephuroceras serratum*, A. Hyatt, Proc. Boston Soc. Nat. Hist. vol. xxii. p. 317.
1884. *Goniatites serratus*, J. M. Clarke, Neues Jahrb. Suppl. vol. iii. p. 326.

Sp. Char. Shell lenticular, with slightly convex sides; greatest thickness close to the umbilical margin, about two-sevenths of the diameter; height of outer whorl nearly one-half of the diameter of the shell. Whorls few; inclusion considerable; umbilicus of medium depth, nearly one-fourth of the diameter of the shell in width. Whorl elongate-oval in section, higher than wide; indented to about one-fourth of its height by the preceding whorl; periphery feebly convex, somewhat flattened, with more or less widely separated, imbricating, rib-like, parabolical swellings, which give the periphery a serrated appearance in a lateral aspect; sides nearly flat; inner margin rounded. Chambers rather shallow; suture-line as in fig. 36. Shell rather thin, with waved transverse striæ,

Fig. 36.



Suture-line of *Gephyroceras serratum* (Steininger).
After Sandberger.

which are fasciculated and raised into folds near the umbilicus. Feeble longitudinal lines on casts. Epidermids consisting of very fine, somewhat jagged, transverse, direct lines; they are distinct on the periphery but disappear at about the middle of the lateral area. Initial chamber globular, compressed.

Size. The largest specimen in the Collection has a diameter of 21 mm.

Form. & Loc. Upper Devonian: Oberscheld, near Dillenburg, Nassau; Büdesheim, Eifel; Winterberg, N.W. Hartz.

75135 a. Fragment, in matrix, showing periphery; Dillenburg. *Toulmin-Smith Collection.*

75140 b. One example, 21 mm. in diameter, in matrix, exhibiting the test; Oberscheld. *Toulmin-Smith Collection.*

C. 1795 h. Three specimens, each about 5 mm. in diameter; two examples, 11 and 17 mm. in diameter respectively; a

portion of a specimen 20 mm. in diameter and several fragments; Büdesheim. Some of these specimens show the epidermids.

Presented by John Edward Lee, Esq., 1885.

C. 4432. Fragment, in matrix, showing periphery; Winterberg.
Purchased.

C. 4433. Two specimens, 15 and 18 mm. in diameter respectively; Winterberg. *Purchased.*

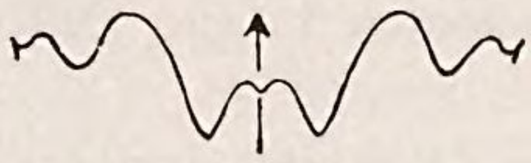
C. 4434. One well-preserved example, 9 mm. in diameter; Büdesheim. *History unknown.*

Gephyroceras planorbe (G. & F. Sandberger).

1850–56. *Goniatites planorbis,* G. & F. Sandberger, Verstein. rhein. Schichtensyst. Nassau, p. 96, pl. ix. ff. 3, 3 *a–g*.
1851. *Goniatites planorbis,* G. Sandberger, Jahrb. Nassau Ver. Nat. vol. vii. pts. 2 & 3, p. 304, pl. iii. f. 32.
1884. *Gephuroceras planorbe,* A. Hyatt, Proc. Boston Soc. Nat. Hist. vol. xxii. p. 317.

Sp. Char. Shell discoidal, much compressed; greatest thickness near the edge of the umbilicus, somewhat variable, from one-sixth to two-ninths of the diameter of the shell; height of outer whorl nearly one-third of the diameter of the shell. Whorls six or seven; almost evolute; umbilicus wide and shallow. Whorl sublanceolate to elongate-oval in section, higher than wide; not much indented by the preceding whorl; periphery usually flattened and with subangular margins, sometimes convex, somewhat concave in casts; sides feebly convex, with a shallow groove near the periphery; inner margin

Fig. 37.



Suture-line of *Gephyroceras planorbe* (G. & F. Sandberger).
After Sandberger.

rounded, imperfectly defined. Chambers rather shallow; suture-line as in fig. 37. Test with fine transverse, forwardly-inclined striæ, which on the last whorl are falciform, their convexity being directed obliquely forward; between the fine striæ broader depressions of a similar form, which near the periphery become deeper and of a crescentic shape; peripheral sinus with its concavity directed

forward, not very deep. Initial chamber rather small, globular, compressed.

Size. The largest specimen figured by G. & F. Sandberger has a diameter of 31 mm.

Form. & Loc. Upper Devonian: Eibach, near Dillenburg, Nassau.

C. 4463. Portion of outer whorl of an example 17 mm. in diameter, imbedded in matrix; and a specimen 9 mm. in diameter, also in matrix.

Transferred from Museum of Practical Geology

Family MAGNOSELLARIDÆ.

(*Magnosellares*, Sandberger; *Acutolaterales*, Sandberger; *Simplices* p. p., and *Æquales*, Beyrich.)

Peripheral lobe undivided, sometimes narrow, infundibuliform; on the side a large lateral saddle, which is sometimes divided by a secondary lobe.

Genus **TORNOCERAS**[1], A. Hyatt[2].

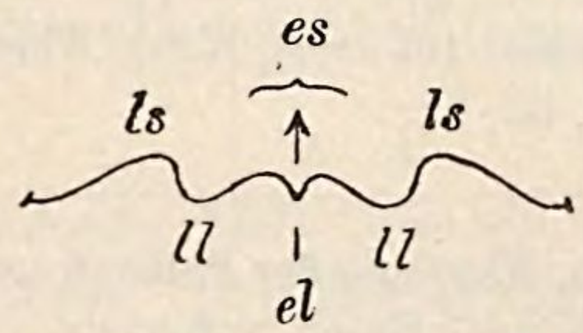
Syn. *Parodiceras*, A. Hyatt, *op. cit.* p. 319.
Heminautilinus, A. Hyatt, *op. cit.* p. 310.

Type. *Goniatites uniangularis*, T. A. Conrad, Journ. Acad. Nat. Sci. Philadelphia, vol. viii. 1842, p. 268, pl. xvi. fig. 4; J. Hall, Nat. Hist. N. York, Palæont. vol. v. pt. 2, p. 444, pl. lxxi. fig. 14, pl. lxxii. figs. 6, 7, pl. lxxiv. fig. 2

Gen. Char. Mostly involute, with closed umbilicus; periphery rounded. Suture-line with large, undivided, rounded lateral saddle; small infundibuliform peripheral lobe; simple peripheral saddle; and, under the suture, a small saddle present near the antiperipheral lobe; lateral lobe angular or rounded.

Devonian.

Fig. 38.



Suture-line of *Tornoceras uniangulare* (Conrad); after Hall.—*el*, peripheral, external, or outer lobe; *es*, peripheral, external, or outer saddle; *ll*, lateral lobe; *ls*, lateral saddle.

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[1] See fig. 25 *d*, *e*, *f*, p. 69.

[2] Proc. Boston Soc. Nat. Hist. vol. xxii. 1884, p. 320.

Prof. Hyatt defines his genus *Parodiceras* as including "species with whorls in section semilunar; sutures with very broad, generally flattened, and primitive forms of the first pair of saddles, lateral lobes shallow and mostly angular, the magnosellarian saddles often rising, as in the young of *Tornoceras*, above the level of the first pair on the venter [periphery];" while the genus *Tornoceras* of the same author includes "species which are similar to *Parodiceras*, but have compressed whorls and annular lobes. The sutures have rounded saddles on the venter [periphery] and rounded lateral lobes with the typical magnosellarian saddles of the family. The first pair of saddles have no corresponding saddles on the dorsum [antiperipheral area], and the annular lobes are situated immediately between the large dorsal saddles corresponding to the magnosellarian saddles. The ventral lobes and sutures in the larval stages are similar to the adults of *Anarcestes*. The stage at which the ventral saddles are in a primitive condition has close resemblance to the older stages of *Parodiceras*."

We have followed those palæontologists [1] who, regarding the distinctions between Hyatt's two genera as not of generic importance, have united the two divisions under the name *Tornoceras*. Although *Parodiceras* was described first, Hyatt himself regarded the latter as "transitional from *Anarcestes* to *Tornoceras*," and it therefore seems preferable to retain the name *Tornoceras* rather than *Parodiceras*.

Hyatt's *Heminautilinus* was founded upon Münster's erroneous figure of *Goniatites hybridus* [2], which according to C. W. Gümbel [3] is a specimen of Münster's *Goniatites linearis*.

Tornoceras undulosum (Münster).

1832. *Goniatites undulosus, sublævis*, G. Münster, Ueber Planul. & Goniat. p. 20, pl. iv. ff. 2 *a–c*, 3 *a–d*.
1843. *Goniatites undulosus, sublævis*, G. Münster, Beiträge zur Petrefactenkunde, i. 2nd ed. pp. 15 & 45, pl. iv.[a] ff. 2, 3.
1850. *Aganides undulosus, sublævis*, A. d'Orbigny, Prod. de Paléont. stratigr. vol. i. pp. 60, 61.

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[1] Steinmann & Döderlein, Elemente der Paläontologie, Part 2, p. 392 (1890); F. Frech, Zeitschr. deutsch. geol. Gesell. vol. xxxix. (1887) p. 485 [*Goniatites* (*Tornoceras*) *biarcuatus* and *curvispina*, which Hyatt refers to *Parodiceras*; *Gon.* (*Torn.*) *simplex*, *auris*, &c., which Hyatt refers to *Tornoceras*]; K. A. von Zittel, Grundzüge der Palæontologie, 1895, p. 398; E. Holzapfel, Abhandl. d. k. Preuss. geol. Landesanst. n. s. Heft xvi. 1895, p. 80.

[2] Ueber Planul. & Goniat. 1832, p. 19, pl. iii. ff. 6 *a*, *b*, *c*.

[3] Neues Jahrb. 1862, p. 300.

1850–56. *Goniatites retrorsus, biarcuatus*, G. & F. Sandberger, Verstein. rhein. Schichtensyst. Nassau, p. 100, pl. x. f. 5 ; pl. x.[b] ff. 16, 17.

1862. *Goniatites undulosus, sublævis*, G. Münster, = *Goniatites retrorsus biarcuatus*, G. & F. Sandberger, C. W. Gümbel, Neues Jahrb. pp. 293, 294, pl. v. ff. 6, 7.

1884. *Parodiceras undulosum*, A. Hyatt, Proc. Boston Soc. Nat. Hist. vol. xxii. p. 319.

Sp. Char. Shell small, inflated, subglobular ; greatest thickness near the umbilicus, varying from one-half to nearly four-fifths of the diameter ; height of outer whorl about four-sevenths of the diameter of the shell. Whorls five or six ; inclusion complete ; umbilicus closed. Whorl broadly-ovate in section, height sometimes equal to, and sometimes much less than, the width ; indented to more than one-half of its height by the preceding whorl ; periphery broadly convex ; sides convex, slightly depressed close to the umbilicus. Body-chamber occupying at least three-fourths of a whorl. Chambers rather deep, but becoming shallower near the body-chamber ; suture-line as in fig. 39. Test ornamented with fine, distant, imbricating

Fig. 39.

Suture-line of *Tornoceras undulosum* (Münster) ; enlarged twice.
After Sandberger.

lines of growth, which form on the periphery a sinus having its concavity directed forward ; simple constrictions sometimes present, not always completely crossing the shell. (" Wrinkle-layer " composed of very fine, transverse, anastomosing striæ.)

More inflated than *Torn. subpartitum* (Münster) and with a slightly different suture-line.

Size. Shell attaining a diameter of more than 25 mm.

Form. & Loc. Upper Devonian (Clymenien-Kalk) : Gattendorf, near Hof, Bavaria.

62472. Crushed example, 17·5 mm. in diameter, showing the " wrinkle-layer," probably belonging to this species.
Bruckmann Coll.

75134. Piece of matrix containing three specimens, labelled in Münster's handwriting " *Goniatites sublævis* ;" the largest having a diameter of about 10 mm. and showing the very fine and faint lines of growth. *Toulmin-Smith Collection.*

81841. Specimen, 8·5 mm. in diameter, attached to piece of matrix and labelled in Münster's handwriting "*Goniatites sublævis*," doubtfully referable to this species.

History unknown.

81842. Specimen, 14 mm. in diameter, attached to matrix, and a portion of an example, about 8 mm. in diameter, showing the lines of growth, labelled in Münster's handwriting "*Goniatites undulatus*, M." This is possibly intended for "*undulosus*," for, so far as the writers have been able to ascertain, Münster did not describe a species of Goniatite under the name "*G. undulatus*."[1] *History unknown.*

Tornoceras globosum (Münster).

1832. *Goniatites globosus*, G. Münster, Ueber Planul. & Goniat. p. 21, pl. iv. ff. 4 *a–e*.

? 1839. *Goniatites Petraeos*, G. Münster, Beiträge zur Petrefactenkunde, i. p. 18.

1843. *Goniatites globosus*, G. Münster, Beiträge zur Petrefactenkunde, i. 2nd ed. pp. 16 & 45, pl. iv.[a] f. 4.

? 1843. *Goniatites Petraeos*, G. Münster, ibid. i. 2nd ed. p. 45.

1850–56. *Goniatites retrorsus umbilicatus*, G. & F. Sandberger, Verstein. rhein. Schichtensyst. Nassau, p. 100, pl. x. ff. 1, 1 *a–c*, pl. x.[b] ff. 11, 12, 12 *a*, *b*, 13, 13 *a*.

1862. *Goniatites globosus*, G. Münster, =*Goniatites retrorsus umbilicatus*, G. & F. Sandberger, C. W. Gümbel, Neues Jahrb. pp. 294, 314, pl. v. f. 8.

1862. *Goniatites Petraeos*, G. Münster, =*Goniatites retrorsus umbilicatus*, G. & F. Sandberger, C. W. Gümbel, ibid. pp. 291, 314, pl. v. f. 4.

1873. *Goniatites globosus*, E. Kayser, Zeitschr. deutsch. geol. Gesell. vol. xxv. pp. 625, 644.

1884. *Parodiceras globosum*, A. Hyatt, Proc. Boston Soc. Nat. Hist. vol. xxii. p. 319.

1884. *Brancoceras umbilicatum*, A. Hyatt, ibid. vol. xxii. pp. 319, 326.

1887. *Goniatites* (*Tornoceras*) *umbilicatus* (=*globosus*, auct.), F. Frech, Zeitschr. deutsch. geol. Gesell. vol. xxxix. p. 439.

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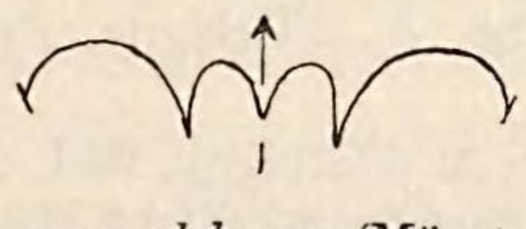
[1] E. Holzapfel (Palæontogr. vol. xxviii. 1882, p. 236) refers to such a species, but does not give any reference.

In his earliest description (Ueber die Planuliten und Goniatiten im Uebergangs-Kalk des Fichtelgebirges, 1832, p. 20, pl. iv. ff. 3 *a–d*), and in the explanation of the figures (p. 38) accompanying the description, Münster names this species *Goniatites undulosus*, but refers to the species in the list on p. 35 as "*Goniatites undulatus, n.*" Similarly in his Beiträge (Heft i. 2nd edit. 1843, p. 15, pl. iv.[a] ff. 3 *a–d*), Münster uses the name *Goniatites undulosus* in his description of the species and in the explanation of the figures (p. 30), but in the list on p. 27 refers to the species as "*Goniatites undulatus, n.*"

[*Not* 1841. *Goniatites globosus*, J. Phillips, Pal. Foss. Cornwall, Devon & West Somerset (Mem. Geol. Surv.), p. 120, pl. l. f. 231.—1888. *Goniatites globosus*, R. Etheridge, Brit. Foss. pt. i., Palæozoic, p. 167.—1890. *Goniatites globosus*, G. F. Whidborne, Devon. Fauna S. England (Mon. Palæontogr. Soc.), pt. ii. p. 67, pl. v. ff. 12, 12 *a*, *b*; pl. vi. ff. 5, 5 *a*.]

Sp. Char. Shell spherical, umbilicated; greatest thickness at the margin of the umbilicus, four-fifths of, or sometimes equal to, the diameter; height of outer whorl about two-fifths of the diameter of the shell. Whorls eight or nine; inclusion almost complete; umbilicus deep, with angular edges, moderately wide, one-third or one-fourth of the diameter of the shell, exposing the edges of the inner whorls. Whorl semilunate in section, much wider than high, indented to about one-half of its height by the preceding whorl; periphery broadly convex; sides convex; inner area well-defined, almost perpendicular to the plane of symmetry. Body-chamber occupying more than one and a half whorls. Chambers of moderate depth; suture-line as in fig. 40. Test ornamented with simple distant striæ. Initial chamber of moderate size, globular.

Fig. 40.



Suture-line of *Tornoceras globosum* (Münster). After Gümbel.

Gümbel (*loc. cit.* p. 291) regards *Gon. Petraeos*, Münster, as synonymous with the present species. Münster described his species as not umbilicated, but Gümbel says it is narrowly but deeply umbilicated. The specimen in the collection labelled "*Goniatites Petraeos*" in Münster's handwriting has a closed umbilicus.

Size. Shell attaining a diameter of nearly 40 mm.

Form. & Loc. Upper Devonian: Gattendorf, near Hof, Bavaria (Clymenien-Kalk); Vailhan (Hérault), France; (? Saltern Cove, near Torquay, S. Devon; and Trevone, near Padstow, Cornwall).

81836. A somewhat distorted specimen, 14 mm. in diameter, showing two constrictions, a portion of the test, but no suture-line. The specimen is labelled "*Goniatites Petraeos*" in Münster's handwriting. Gattendorf.

History unknown.

81861. A nearly spherical example, 13·5 mm. in diameter, much obscured by matrix, labelled "*Goniatites globosus*" in Münster's handwriting; Gattendorf. *History unknown.*

C. 1753 d. Specimen, 4 mm. in diameter, doubtfully referable to this species; Saltern Cove, near Torquay.
Presented by John Edward Lee, Esq., 1885.

C. 1799. Two examples, each about 3 mm. in diameter, doubtfully referable to this species; Saltern Cove, near Torquay.
Presented by John Edward Lee, Esq., 1885.

C. 4788. Specimen 6·5 mm. in diameter; Vailhan (Hérault), France.
Purchased, 1894.

C. 4866. Example 6·5 mm. in diameter, partly imbedded in matrix, probably belonging to this species.
Presented by Howard Fox, Esq., F.G.S., 1894.

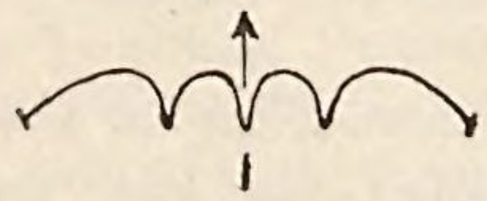
Tornoceras lineare (Münster).

1832. *Goniatites hybridus*, G. Münster, Ueber Planul. & Goniat. p. 19, pl. iii. ff. 6 *a*, *b*, *c*.
1832. *Goniatites linearis*, G. Münster, ibid. p. 22, pl. v. ff. 1 *a–d*.
1843. *Goniatites hybridus*, G. Münster, Beitr. zur Petrefactenkunde, i. 2nd ed. p. 14, pl. iii.[a] ff. 6 *a*, *b*, *c*.
1843. *Goniatites linearis*, G. Münster, ibid. i. 2nd ed. p. 17, pl. v.[a] ff. 1 *a*, *b*, *c*, *d*.
1850. *Aganides hybridus*, A. d'Orbigny, Prod. de Paléont. stratigr. vol. i. p. 59.
1850. *Aganides linearis*, A. d'Orbigny, ibid. vol. i. p. 59.
1852. *Ammonites retrorsus* (pars), C. G. Giebel, Fauna der Vorwelt, vol. iii. p. 457.
1862. *Goniatites linearis*, C. W. Gümbel, Neues Jahrb. p. 296, pl. v. f. 10.
1862. *Goniatites hybridus*, G. Münster, = *Goniatites linearis*, G. Münster, C. W. Gümbel, Neues Jahrb. p. 300.
1880. *Goniatites linearis*, W. Branco, Palæontogr. vol. xxvii. pl. v. ff. 6 *a*, *b*.
1884. *Brancoceras lineare*, A. Hyatt, Proc. Boston Soc. Nat. Hist. vol. xxii. p. 326.
1884. *Heminautilinus hybridus*, A. Hyatt, ibid. vol. xxii. p. 310.
1887. *Goniatites* (*Tornoceras*) *linearis*, F. Frech, Zeitschr. deutsch. geol. Gesell. vol. xxxix. pp. 372, 448.
1892. *Goniatites* (*Brancoceras*) *linearis*, F. Lœwinson-Lessing, Bull. Soc. Belge de Géologie, de Paléont. &c. vol. vi. Mémoires, p. 23.

Sp. Char. Shell spheroidal, somewhat compressed, involute; greatest thickness near the umbilicus, about three-sevenths of the diameter; height of outer whorl about four-sevenths of the diameter of the shell. Number of whorls (?); inclusion complete; umbilicus closed. Whorl oval in section, higher than wide, indented to about two-thirds of its height by the preceding whorl; periphery

more or less broadly rounded; sides convex, somewhat depressed at the umbilicus. Body-chamber occupying one and a half whorls. Chambers not very deep, twelve to thirteen to a whorl; suture-line as in fig. 41. Test ornamented with very fine, elevated, curved,

Fig. 41.



Suture-line of *Tornoceras lineare* (Münster); reduced one-half.
After Gümbel.

transverse striæ, scarcely visible without a lens; outer whorl (in casts) bearing four feebly-curved constrictions, corresponding in direction with the shell ornaments. Initial chamber ovoid, its longer axis transverse. Epidermids consisting of fine transverse, oblique, wrinkled striæ.

Size. Shell attaining a diameter of more than 60 mm.

Form. & Loc. Upper Devonian (Clymenien-Kalk): Schübelhammer, Bavaria.

81858. Portion of the outer whorl of a specimen, 47 mm. in diameter, displaying on one side the inner whorls up to a diameter of 34 mm., and exhibiting the ornamentation of the test, labelled "*Goniatites linearis*" in Münster's handwriting.
History unknown.

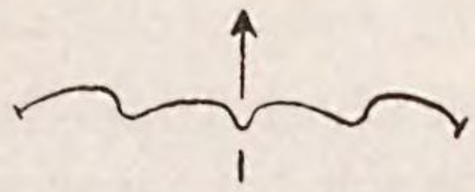
Tornoceras Verneuili (Münster).

1839. *Goniatites Verneuilii*, G. Münster, Beitr. zur Petrefactenkunde, i. p. 17, pl. iii. ff. 9 *a*, *b*, *c*.
1843. *Goniatites Verneuilii*, G. Münster, ibid. i. 2nd ed. p. 44, pl. iii. ff. 9 *a*, *b*, *c*.
1850. *Aganides Verneuili*, A. d'Orbigny, Prod. de Paléont. stratigr. vol. i. p. 61.
1850–56. *Goniatites retrorsus amblylobus*, G. & F. Sandberger, Verstein. rhein. Schichtensyst. Nassau, p. 101, pl. v. f. 4; pl. x. f. 8; pl. x.[a] ff. 20, 23, 24; pl. x.[b] ff. 1–6, 8, 14, 15, 18, 19, 21, 23, 25.
1862. *Goniatites Verneuili*, G. Münster, = *Goniatites retrorsus amblylobus*, G. & F. Sandberger, C. W. Gümbel, Neues Jahrb. p. 290, pl. v. f. 1.
1873. *Goniatites retrorsus amblylobus*, F. Sandberger, ibid. p. 58.
1873. *Goniatites Verneuili* (pars), E. Kayser, Zeitschr. deutsch. geol. Gesell. vol. xxv. p. 623.
1883. *Goniatites Verneuili*, A. von Koenen, Neues Jahrb. ii. p. 171.
1884. *Parodiceras amblylobum*, A. Hyatt, Proc. Boston Soc. Nat. Hist. vol. xxii. pp. 318, 319.

1886. *Goniatites Verneuili*, A. von Koenen, Neues Jahrb. i. p. 164.
1887. *Goniatites* (*Tornoceras*) *Verneuili*, F. Frech, Zeitschr. deutsch. geol. Gesell. vol. xxxix. pp. 371, 372, 380, 388, 439, 448.

Sp. Char. Shell thick, with flattened sides, sometimes biconvex, tumid, not umbilicated, with constrictions ; greatest thickness at or near the edge of the umbilicus, variable, from three-eighths to nearly three-fourths of the diameter ; height of outer whorl from rather more than one-half to three-fifths of the diameter of the shell. Whorls five or six ; inclusion complete ; umbilicus closed, its place occupied by a small infundibuliform depression. Whorl oval in section, higher than wide, indented to more than one-half of its height by the preceding whorl ; periphery convex, sometimes broad, sometimes narrow ; sides convex, their inner portion a little flattened ; inner area very narrow, sloping. Body-chamber occupying a whorl ; aperture not seen. Chambers not very shallow, but becoming much shallower in the last half whorl of the septate portion ; suture-line as in fig. 42. Test ornamented

Fig. 42.



Suture-line of *Tornoceras Verneuili* (Münster).
After Sandberger.

with fine lines of growth, which cross the whorl in a simple backwardly-directed curve, having its convexity directed forward ; with constrictions varying in number, form, and extent, sometimes simply curved, sometimes coinciding with the lines of growth, sometimes curved in an opposite direction, sometimes curved strongly backwards near the periphery, sometimes straight, sometimes completely crossing the whorl, sometimes traversing only the outer portion and sometimes only the inner portion of the whorl. Epidermids very fine, pit-like, increasing in size toward the umbilicus and exhibiting a tendency to arrange themselves in lines coincident with the lines of growth ; at the margin of the umbilicus having the form of fine rugæ.

Size. Shell attaining a diameter of more than 40 mm.

Form. & Loc. Upper Devonian : Nehden, near Brilon, Westphalia ; Neffiès, Vailhan (Hérault), France ; (? Dillenburg and Oberscheld, Nassau ; Saltern Cove, near Torquay, S. Devon).

47648. Three examples in matrix, the largest 20 mm. in diameter, probably belonging to this species ; Dillenburg.
Paul Mohr Collection.

C. 601 c, C. 1753 h, C. 1967 c. Three specimens, 4·5, 5, and 5 mm. in diameter respectively, probably referable to this species; Saltern Cove. *Presented by John Edward Lee, Esq.*, 1885.

C. 1779. Fragment in matrix, showing "wrinkle-layer," possibly referable to this species; Oberscheld.
Presented by John Edward Lee, Esq., 1885.

C. 4612. Four well-preserved examples, ranging in diameter from 15 to 20 mm., two of them showing the epidermids very clearly; also a fragment of a larger and more inflated example, also showing the epidermids: Nehden.
History unknown.

C. 4613. Three well-preserved specimens, ranging in diameter from 13 to 19 mm., and two portions of a somewhat larger specimen; Nehden. *History unknown.*

C. 4623. Several imperfect examples, in matrix, probably referable to this species; Neffiès. *History unknown.*

C. 4624. Inflated example, entirely septate, 13·5 mm. in diameter; (?) Loc. *History unknown.*

C. 4789. Six specimens, ranging in diameter from 5·5 to 10 mm.; Vailhan. *Purchased*, 1894.

C. 5056. Example 16 mm. in diameter; Brilon, Westphalia.
Transferred from Museum of Practical Geology.

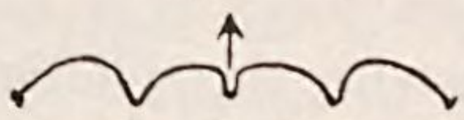
Tornoceras subpartitum (Münster).

1839. *Goniatites subpartitus*, G. Münster, Beitr. zur Petrefactenkunde, i. p. 18.
1843. *Goniatites subpartitus*, G. Münster, Beitr. zur Petrefactenkunde, i. 2nd ed. p. 44.
1850–56. *Goniatites retrorsus angulatus*, G. & F. Sandberger, Verstein. rhein. Schichtensyst. Nassau, p. 100, pl. x. ff. 4, 4 *a*, *b*.
1862. *Goniatites subpartitus*, G. Münster, = *Goniatites retrorsus angulatus*, G. & F. Sandberger, C. W. Gümbel, Neues Jahrb. p. 291, pl. v. f. 3.
1873. *Goniatites subpartitus* (pars), E. Kayser, Zeitschr. deutsch. geol. Gesell. vol. xxv. p. 626.
1883. *Goniatites subpartitus*, A. von Koenen, Neues Jahrb. ii. p. 171.
1886. *Goniatites subpartitus*, A. von Koenen, ibid. i. p. 164.
1887. *Goniatites* (*Tornoceras*) *subpartitus*, F. Frech, Zeitschr. deutsch. geol. Gesell. vol. xxxix. pp. 371, 380, 388, 438.

Sp. Char. Shell flattened, involute, somewhat inflated; greatest thickness near the umbilicus, nearly one-half of the diameter;

height of the outer whorl rather more than one-half of the diameter. Number of whorls (?); inclusion complete; umbilicus closed. Whorl ovate in section, rather higher than wide; indented to about one-half of its height by the preceding whorl; periphery convex; sides feebly convex, somewhat flattened. Body-chamber occupying at least half a whorl. Chambers rather shallow; suture-line as in fig. 43. Test almost smooth, the outer whorl bearing on its inner

Fig. 43.



Suture-line of *Tornoceras subpartitum* (Münster).
After Sandberger.

surface two or three varices, which produce corresponding grooves on casts of the interior, but are not visible on the exterior of the shell.

Greatly resembles *Tornoc. Verneuili* (Münster), but is much less inflated.

Size. Shell attaining a diameter of about 25 mm.

Form. & Loc. Upper Devonian (Clymenien-Kalk): Gattendorf, near Hof, Bavaria.

81844. An example, about 23 mm. in diameter, partly imbedded in matrix, labelled "*Goniatites subpartitus*, var." in Münster's handwriting. *History unknown.*

Tornoceras circumflexum (G. & F. Sandberger).

1850–56. *Goniatites retrorsus circumflexus*, G. & F. Sandberger, Verstein. rhein. Schichtensyst. Nassau, p. 101, pl. x. ff. 9, 9 *a–d*; pl. x.[a] ff. 9, 9 *a*, *b*; pl. x.[b] ff. 26, 26 *a–c*.

1873. *Goniatites Verneuili* (pars), E. Kayser, Zeitschr. deutsch. geol. Gesell. vol. xxv. p. 623.

1884. *Tornoceras circumflexum*, A. Hyatt, Proc. Boston Soc. Nat. Hist. vol. xxii. p. 320.

1887. *Goniatites* (*Tornoceras*) *circumflexus*, F. Frech, Zeitschr. deutsch. geol. Gesell. vol. xxxix. pp. 371, 388, 428, 439.

Sp. Char. Shell moderately thick, somewhat biconvex, more rarely with flattened sides, with closed umbilicus, with or without constrictions; greatest thickness close to the umbilicus, about one-half of the diameter; height of outer whorl about four-sevenths of the diameter of the shell. Whorls about six; inclusion complete; umbilicus closed, its position marked by a narrow, not very deep depression. Whorl elongate-oval in section, higher than wide;

indented to from one-half to two-thirds of its height by the preceding whorl; periphery narrowly, sometimes rather broadly convex; sides feebly convex; inner area narrow, sloping, imperfectly defined. Body-chamber occupying nearly a whorl. Chambers moderately shallow; suture-line as in fig. 44. Test ornamented with fine,

Fig. 44.

Suture-line of *Tornoceras circumflexum* (G. & F. Sandberger); enlarged.
After Sandberger.

backwardly-directed, curved lines of growth having their convexity directed forward; constrictions coincident with the lines of growth usually extending from the periphery to the middle of the lateral area, sometimes absent.

Size. Shell attaining a diameter of 30 mm.

Form. & Loc. Upper Devonian: Nehden, near Brilon, Eifel; (? Büdesheim, Eifel); Vailhan (Hérault), France.

C. 4621. Three fairly well-preserved specimens, natural casts, ranging from 18 to 24 mm. in diameter; Nehden.

History unknown.

C. 1811 e. A compressed specimen, 12 mm. in diameter, apparently intermediate between this species and *Tornoc. Ausavense.* Its general form greatly resembles that of the latter species, but its suture-line is like that of the present species. Büdesheim.

Presented by John Edward Lee, Esq., 1885.

C. 4787. One example, 12 mm. in diameter; Vailhan.

Purchased, 1894.

Tornoceras acutum (Münster).

1840. *Goniatites acutus*, G. Münster, Beiträge zur Petrefactenkunde, pt. iii. p. 110, pl. xvi. ff. 11 *a*, *b*.

1850. *Aganides acutus*, A. d'Orbigny, Prod. de Paléont. stratigr. vol. i. p. 58.

1852. *Ammonites acutus*, C. G. Giebel, Fauna der Vorwelt, vol. iii. p. 468 (*not* J. Sowerby).

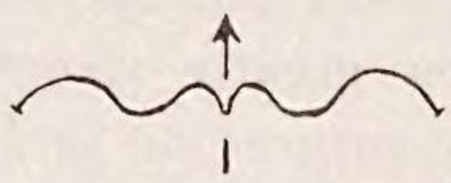
? 1853. *Goniatites acutus*, H. B. Geinitz, Verstein. Grauwacken-formation, pt. ii. p. 39, pl. ix. ff. 19, 20.

1850-56. *Goniatites retrorsus acutus*, G. & F. Sandberger, Verstein. rhein. Schichtensyst. Nassau, p. 101, pl. x. ff. 10, 10 *a*, *b*; pl. x^{a}. ff. 1, 2, 2 *a*, *b*.

1862. *Goniatites acutus*, G. Münster, = *Goniatites retrorsus acutus*, G. & F. Sandberger, C. W. Gümbel, Neues Jahrb. pp. 308, 317.
1873. *Goniatites acutus*, E. Kayser, Zeitschr. deutsch. geol. Gesell. vol. xxv. p. 622.
? 1884. *Goniatites acutus*, A. Krasnopolski, Berichte geol. Com., St. Petersburg, vol. iii. no. 4, p. 123.
1884. *Tornoceras acutum*, A. Hyatt, Proc. Boston Soc. Nat. Hist. vol. xxii. p. 320.
1889. *Goniatites acutus*, E. Kayser, Neues Jahrb. i. p. 184.
Not 1846. *Goniatites acutus*, A. v. Keyserling, Petschora-Land, p. 280, pl. xii. ff. 6, 6 *a*, *b*.

Sp. Char. Shell not very thick, without constrictions, biconvex, lenticular, with acute periphery; greatest thickness at a short distance from the edge of the umbilicus, one-half of the diameter; height of outer whorl rather more than one-half of the diameter of the shell. Whorls six; inclusion complete; umbilicus very small, infundibuliform, not exposing the inner whorls. Whorl sub-triangular in section, indented to one-half of its height by the preceding whorl; periphery acute in the adult, but more obtuse in the young; sides convex, somewhat flattened towards their inner margin; inner margin imperfectly defined, convex. Body-chamber occupying three-fourths of the last whorl; aperture not seen. Chambers shallow; suture-line as in fig. 45. Test nearly smooth,

Fig. 45.



Suture-line of *Tornoceras acutum* (Münster).
After Sandberger.

with feeble, subimbricating, curved, backwardly-directed lines of growth, having their convexity directed forward, without constrictions.

This species has a suture-line closely resembling that of *Torn. circumflexum* (G. & F. Sandb.), but differs both from the latter and from *Torn. Verneuili* (Münster) in its acute periphery and in the absence of constrictions.

Size. Shell attaining a diameter of 32 mm.
Form. & Loc. Upper Devonian: Nehden, near Brilon, Eifel.

C. 4611. Imperfect but fairly well-preserved specimen, about 20 mm. in diameter, wanting the peripheral portion of the greater part of the body-chamber.

History unknown.

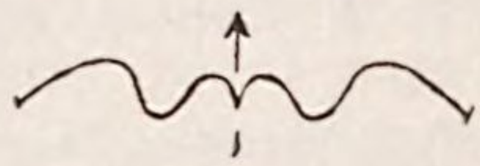
Tornoceras auris (F. A. Quenstedt).

? 1842. *Goniatites paucistriatus*, d'Archiac & de Verneuil, Trans. Geol. Soc. [2] vol. vi. p. 339, pl. xxv. ff. 8, 8 *a*, *b*.
1846–49. *Goniatites auris*, F. A. Quenstedt, Petrefactenk. Deutschl. vol. i. Cephalopoden, p. 64, pl. iii. ff. 7 *a*, *b*, *c*.
1849. *Goniatites auris*, J. Steininger, Verstein. Uebergangsgeb. Eifel, p. 27.
1849. *Goniatites Eifliensis* (pars), J. Steininger, ibid. p. 27.
1849. *Goniatites constrictus*, J. Steininger, ibid. p. 27.
? 1850. *Aganides paucistriatus*, A. d'Orbigny, Prod. de Paléont. stratigr. vol. i. p. 60.
1850. *Goniatites Auris*, F. A. Roemer, Palæontogr. vol. iii. p. 40, pl. vi. ff. 11 *a*, *b*, *c*, *d*.
1850. *Goniatites discus*, F. A. Roemer, ibid. vol. iii. p. 39, pl. vi. ff. 7 *a*, *b*, *c*.
1850. *Goniatites Auris*, F. A. Roemer, Beitr. geol. Kenntn. nordwestl. Harzgeb. i. p. 40, pl. vi. ff. 11 *a*, *b*, *c*, *d*.
1850. *Goniatites discus*, F. A. Roemer, ibid. i. p. 39, pl. vi. ff. 7 *a*, *b*, *c*.
1852. *Ammonites retrorsus* (pars), C. G. Giebel, Fauna der Vorwelt, vol. iii. p. 457.
1853. *Goniatites auris*, J. Steininger, Geogn. Beschr. Eifel, p. 43.
1853. *Goniatites Eifliensis* (pars), J. Steininger, ibid. p. 43, pl. i. ff. 3, 3 *a* (*not* 2, 2 *a*).
1853. *Goniatites constrictus*, J. Steininger, ibid. p. 43, pl. i. ff. 9, 9 *a*.
1850–56. *Goniatites retrorsus auris*, G. & F. Sandberger, Verstein. rhein. Schichtensyst. Nassau, p. 101, pl. x. ff. 11–13; pl. x^{a}. ff. 8, 12–19.
1850–56. *Goniatites retrorsus undulatus* (pars), G. & F. Sandberger, ibid. p. 101, pl. x. ff. 17, 17 *a*, 18 (? 19) (*not* pl. x^{a}. ff. 7, 7 *a*, *b*).
1867. *Goniatites ammonitoides*, W. Trenkner, Paläont. Novit. i. p. 6, pl. i. ff. 7 *a*, *b*.
1876. *Goniatites auris*, F. Roemer, Lethæa Geogn. pt. i. pl. xxxv. ff. 12 *a*, *b*.
1877. *Goniatites auris*, J. E. Lee, Geol. Mag. [2] vol. iv. p. 101, pl. v. ff. 1, 2 *a*, *b*.
1882. *Goniatites auris*, E. Holzapfel, Palæontogr. vol. xxviii. p. 236.
1884. *Tornoceras auris*, A. Hyatt, Proc. Boston Soc. Nat. Hist. vol. xxii. p. 320.
1884. *Goniatites auris*, J. M. Clarke, Neues Jahrb., Suppl. vol. iii. p. 328.
1887. *Goniatites* (*Tornoceras*) *auris*, F. Frech, Zeitschr. deutsch. geol. Gesell. vol. xxxix. pp. 384, 428.

Sp. Char. Shell variable, flattish, sometimes somewhat inflated; greatest thickness nearly at the middle of the lateral area or near the margin of the umbilicus, about one-half of the diameter; height of outer whorl variable, from two-fifths to about two-thirds of the diameter of the shell. Whorls five; inclusion variable, sometimes

nearly complete; umbilicus either closed, or narrow, or moderately wide, attaining rarely a width of nearly one-third of the diameter of the shell. Whorl elongate-oval to subquadrate in section, about as high as wide; indented to from two-fifths to nearly one-half of its height by the preceding whorl; periphery flattened, wide, having the appearance of a squamous, or transversely furrowed band, with subangular margins, bounded by two shallow, more or less strongly marked, longitudinal grooves; sides flattened, more or less convex; inner area sloping, not sharply defined. Body-chamber occupying nearly a whorl. Chambers shallow, fifteen or sixteen in a whorl; suture-line as in fig. 46. Test ornamented with simple,

Fig. 46.



Suture-line of *Tornoceras auris* (Quenstedt); enlarged.
After Sandberger.

elevated, very fine striæ, some of which are often more prominent than the rest; or with more or less numerous imbricating folds bearing fine striæ; passing from the suture, the ornaments go sometimes straight over two-thirds of the lateral area, and sometimes on leaving the suture turn a little forward, then backward, and then considerably forward into the shallow groove; here recurving suddenly, they form a narrow sinus having its concavity directed backward, and then form on the periphery a sinus, wider, more rounded and not so deep as the preceding, having its concavity directed forward. Constrictions seldom present; but when present following the direction of the shell-ornaments.

Size. Shell attaining a diameter of about 17 mm.

Form. & Loc. Upper Devonian: Büdesheim, Eifel; Oberscheld, near Dillenburg, and Bicken, near Herborn, Nassau; Adorf, Waldeck; Saltern Cove, near Torquay, S. Devon.

The examples from Nassau and Waldeck are referable to *Goniatites paucistriatus*, d'Archiac and de Verneuil, a species probably identical with *Gon. auris*, Quenstedt, but the suture-line was unknown to the authors of the species and has not been seen by the present writers.

Unless otherwise stated, the examples of this species in the Collection were presented by John Edward Lee, Esq., 1885.

(i.) *Büdesheim, Eifel.*

47652, 47653, 47655 a, 47657, 47658. Nineteen examples, ranging from 5 to 16 mm. in diameter. *Paul Mohr Collection.*

C. 1789. Six examples, ranging from 5 to 15 mm. in diameter.

C. 1795 i. Ninety-eight specimens, ranging in diameter from 4 to 14 mm.

C. 1798 b. Four specimens, ranging from 5·5 to 15 mm. in diameter, in matrix.

C. 1811 c. Six examples, ranging in diameter from 5·5 to 10 mm.

C. 2119. One specimen, 8 mm. in diameter.

C. 4607. Five examples, ranging in diameter from 9 to 13·5 mm.
History unknown.

C. 4608. Ten specimens, ranging from 5 to 14 mm. in diameter. In one specimen the last twelve chambers are much shallower than the rest in the same whorl.
History unknown.

C. 4609. Thirteen examples, ranging from 7 to 12 mm. in diameter.
History unknown.

(ii.) *Nassau.*

C. 1774. Slab, in counterpart, containing an example 10 mm. in diameter, and a fragment of a somewhat larger specimen; Oberscheld, near Dillenburg.

C. 1778. Small slab, in which is embedded a specimen 11·5 mm. in diameter and a portion of a somewhat smaller example; Oberscheld, near Dillenburg.

C. 4629. Five well-preserved specimens, ranging in diameter from 7 to 17 mm.; Bicken, near Herborn.

(iii.) *Adorf, Waldeck.*

C. 1846 a. Small slab, containing two examples, 10 and about 7 mm. in diameter respectively; also a small slab containing an example 12 mm. in diameter.

C. 2118 j. Two specimens, 7·5 and 11 mm. in diameter respectively, in matrix.

(iv.) *Saltern Cove, near Torquay, S. Devon.*

C. 601. Three specimens, ranging in diameter from 4 to about 13 mm., in matrix.

C. 601 a. An example, 7 mm. in diameter, showing the suture-line, in matrix.

C. 1753 e. Five fairly well-preserved examples, ranging from 7 to 11·5 mm. in diameter; two exhibiting the suture-line somewhat indistinctly: also a specimen 5 mm. in diameter doubtfully referable to this species.

C. 1753 f. Distorted outer whorl of a specimen, 10 mm. in diameter, with wide umbilicus and with no trace of the suture-line, probably belonging to this species.

C. 1799 a, C. 1811 d. Two well-preserved specimens, 4 and 5·5 mm. in diameter respectively.

C. 1824, C. 1960 a. Eight more or less imperfect examples, all but one in matrix.

C. 1961 c. Eight more or less imperfect specimens, the largest having a diameter of 10 mm.; two of the examples displaying the suture-line.

C. 1963. A specimen, 6 mm. in diameter; and a more inflated example, 8 mm. in diameter, doubtfully referable to this species.

C. 1967 b. Thirteen more or less imperfect specimens, the majority in matrix.

C. 1967 c. One example, 11 mm. in diameter, exhibiting the suture-line very clearly.

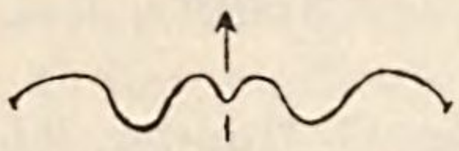
Tornoceras Ausavense (J. Steininger).

? 1846. *Goniatites strangulatus*, A. v. Keyserling, Petschora-Land, p. 277, pl. xii. ff. 4, 4 *a*, *b*, *c*.
1849. *Goniatites Ausavensis*, J. Steininger, Verstein. Uebergangsgeb. Eifel, p. 27.
1853. *Goniatites Ausavensis*, J. Steininger, Geogn. Beschreib. Eifel, p. 43, pl. i. ff. 6, 6 *a*, 7, 7 *a*.
1877. *Goniatites ausavensis*, J. E. Lee, Geol. Mag. [2] vol. iv. p. 101, pl. v. ff. (? 5), 6.

Sp. Char. Shell much compressed, involute, outer whorl crossed by five constrictions; greatest thickness near the edge of the umbilicus, two-fifths of the diameter; height of outer whorl three-fifths of the diameter of the shell. Whorls five or six; inclusion almost complete; umbilicus very small, shallow, sides sloping, margin not sharply defined, not exposing the inner whorls. Whorl elongate-oval in section, indented to about two-fifths of its height by the preceding whorl; periphery narrowly rounded, somewhat flattened, with subangular edges; sides flattened, slightly convex; inner

margin sloping, imperfectly defined. Body-chamber occupying nearly a whorl; aperture not seen. Chambers rather shallow, twenty-two in a whorl; suture-line as in fig. 47. Test ornamented with fine subregular transverse striæ, which form on the

Fig. 47.



Suture-line of *Tornoceras Ausavense* (Steininger); traced from specimen no. C. 1811 *g*, and enlarged twice.

lateral area a shallow sinus having its concavity directed forward, bend abruptly backward near the peripheral margin, and cross the periphery in a rather deep sinus having its concavity directed forward. Constrictions following nearly the same course as the ornaments, but bending backward less abruptly at the peripheral margin, and forming a shallower sinus on the periphery.

This species is near to *Tornoceras Verneuili* (Münster) and *Tornoc. circumflexum* (G. & F. Sandberger), but differs from the former in having a less inflated form, and in its suture-line possessing a much more elevated peripheral saddle; whilst from the latter it may be distinguished by the character of its constrictions and the ornamentation of the test.

Size. The largest specimen in the Collection has a diameter of 11 mm.

Form. & Loc. Upper Devonian: Büdesheim, Eifel.

C. 1791 a, C. 1795 l, C. 1811 g. Eight specimens, ranging in diameter from 4·5 to 11 mm.; the suture-line of the largest of the specimens, bearing the no. C. 1811 *g*, is represented in fig. 47. *Presented by John Edward Lee, Esq.*, 1885.

C. 4610. Two examples, 7 and 8 mm. in diameter respectively.
History unknown.

Tornoceras simplex (v. Buch).

[Fig. 25 *d*, *e*, *f*, p. 69.]

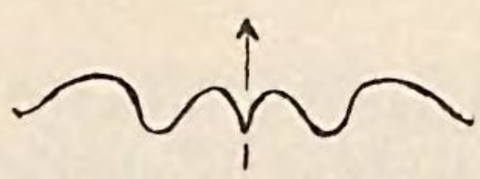
1832. *Ammonites simplex*, L. v. Buch, Phys. Abhandl. k. Akad. Wiss. Berlin, for 1830, p. 174, pl. ii. f. 8.
1832. *Goniatites ovatus*, G. Münster, Ueber Planulit. und Goniat. p. 18, pl. iv. ff. 1 *a–d*.
1837. *Ammonites retrorsus*, H. E. Beyrich, De Goniatitis in montibus rhenanis occurrentibus, p. 6, pl. i. ff. 10 *a–c*; and Beitr. Kenntn. Verstein. rhein. Uebergangsgeb. pt. i. p. 30, pl. i. ff. 10 *a–c*. (*Not* v. Buch.)

1839. *Goniatites ovatus*, G. Münster, Beiträge zur Petrefactenkunde, i. p. 18.
1839. *Goniatites striatulus*, G. Münster, ibid. i. p. 20.
1840. *Goniatites ovatus*, G. Münster, ibid. iii. p. 106.
1840. *Goniatites striatulus*, G. Münster, ibid. iii. p. 107.
1842. *Goniatites striatulus*, G. Münster, ibid. v. p. 127, pl. xii. ff. 8 *a*, *b*.
1843. *Goniatites ovatus*, G. Münster, ibid. i. 2nd ed. pp. 14 & 44, pl. iv^{a}. ff. 1 *a–d*.
1843. *Goniatites striatulus*, G. Münster, ibid. i. 2nd ed. p. 46.
1843. *Goniatites nummularius*, F. A. Roemer, Verstein. Harzgeb. p. 35, pl. ix. ff. 16 *a–c*.
1846. *Goniatites retrorsus*, F. A. Quenstedt, Petref. Deutschlands, vol. i. (Cephalopoda), p. 63, pl. iii. ff. 8 *a*, *b*, *c*.
1849. *Goniatites Eifliensis* (pars), J. Steininger, Verstein. Uebergangsgeb. Eifel, p. 27.
1851. *Goniatites retrorsus*, G. Sandberger, Jahrb. Nassau Ver. Nat. vol. vii. pts. 2, 3, p. 295, pl. ii. ff. 6, 8; p. 297, pl. iii. f. 20; (? p. 303, pl. iii. f. 37).
? 1853. *Goniatites Eifliensis* (pars), J. Steininger, Geol. Beschr. Eifel, p. 43, pl. i. ff. 2, 2 *a* (*not* 3, 3 *a*).
1850–56. *Goniatites retrorsus typus*, G. & F. Sandberger, Verstein. rhein. Schichtensyst. Nassau, p. 100, pl. x. ff. 14–16; pl. x^{a}. ff. 3–6, 10, 11, 21, 22.
1850–56. *Goniatites retrorsus lingua*, G. & F. Sandberger, ibid. p. 101, pl. x. ff. 20, 21.
1850–56. *Goniatites retrorsus undulatus* (pars), G. & F. Sandberger, ibid. p. 101, pl. x^{a}. f. 7; ? pl. x. f. 19 (*not* pl. x. ff. 17, 18).
1862. *Goniatites ovatus*, G. Münster, = *Goniatites retrorsus typus*, G. & F. Sandberger, C. W. Gümbel, Neues Jahrb. pp. 290, 316, pl. v. f. 2.
1862. *Goniatites striatulus*, G. Münster, = *Goniatites retrorsus typus*, G. & F. Sandberger, C. W. Gümbel, ibid. pp. 30, 316.
1867. *Goniatites retrorsus typus*, W. Trenkner, Paläont. Novit. i. p. 5, pl. i. ff. 5 *a*, *b*, 6 *a*, *b*.
1872. *Goniatites retrorsus typus*, G. & F. Sandberger, = *Goniatites simplex*, L. v. Buch, E. Kayser, Zeitschr. deutsch. geol. Gesell. vol. xxiv. p. 665.
1873. *Goniatites simplex*, E. Kayser, Zeitschr. deutsch. geol. Gesell. vol. xxv. p. 620, pl. xix. f. 6.
1877. *Goniatites retrorsus*, J. E. Lee, Geol. Mag. [2] vol. iv. p. 101, pl. v. ff. 3, 4.
1882. *Goniatites simplex*, E. Holzapfel, Palæontogr. vol. xxviii. p. 236.
1883. *Goniatites simplex*, A. von Koenen, Neues Jahrb. ii. p. 171.
1884. *Tornoceras retrorsum*, vars. *undulatus* and *typus*, A. Hyatt, Proc. Boston Soc. Nat. Hist. vol. xxii. p. 320.
1884. *Goniatites retrorsus typus*, G. & F. Sandberger, = *Ammonites simplex*, L. v. Buch, E. Beyrich, Zeitschr. deutsch. geol. Gesell. vol. xxxvi. p. 212.

1884. *Goniatites simplex*, J. M. Clarke, Neues Jahrb., Suppl. vol. iii. p. 331.
1884. *Goniatites retrorsus*, A. Krasnopolski, Berichte geol. Com., St. Petersburg, vol. iii. no. 4, p. 123.
1886. *Goniatites simplex*, A. von Koenen, Neues Jahrb. i. p. 164.
1887. *Goniatites* (*Tornoceras*) *simplex*, F. Frech, Zeitschr. deutsch. geol. Gesell. vol. xxxix. pp. 377, 389, 428.
1889. *Goniatites simplex*, E. Kayser, Neues Jahrb. i. p. 184.

Sp. Char. Shell rather flat, rarely more spherical, with closed umbilicus; young usually more spherical than adult, with a narrow umbilicus; greatest thickness close to the umbilicus, from one-half to three-fifths of the diameter; height of outer whorl about three-fifths of the diameter. Whorls about six; inclusion complete; umbilicus closed, its position marked by a very small depression. Whorl parabolic in section, higher than wide; indented to about two-fifths of its height by the preceding whorl; periphery convex; sometimes slightly flattened; sides flattened; inner area very narrow, sloping. Body-chamber occupying nearly a whorl. Chambers varying in depth, usually shallow, sometimes rather deep; suture-line as in fig. 48. Test sometimes almost smooth, ornamented with faint lines of growth, or with waved or falciform ribs

Fig. 48.



Suture-line of *Tornoceras simplex* (v. Buch).
After Sandberger.

and folds, which have their concavity directed forward, bending somewhat abruptly backward at the peripheral margin and forming on the periphery a deep parabolical or linguiform sinus having its concavity directed forward. Casts sometimes with feeble longitudinal lines.

Size. Shell sometimes (but rarely) attaining a diameter of more than 75 mm.

Form. & Loc. Upper Devonian: Büdesheim, Eifel; Eibach, near Dillenburg, Nassau; Grund, Winterberg, and Kellwasser, near Altenau, N.W. Hartz; Brilon, Westphalia; Gattendorf, near Hof, Bavaria; Lower Dunscombe, near Chudleigh, S. Devon; Saltern Cove, near Torquay, S. Devon.

All the specimens in the Collection illustrating this species were presented by John Edward Lee, Esq., 1885, unless otherwise stated.

(i.) *Büdesheim, Eifel.*

47655 b. Five more or less imperfect specimens, ranging in diameter from 6 to 14 mm. *Paul Mohr Collection.*

47657 a. Seven examples, ranging in diameter from 6 to 20 mm. *Paul Mohr Collection.*

89185 d. Seven fairly well-preserved specimens, ranging in diameter from 10 to 22 mm.; also a flattened and much abraded example, 38 mm. in diameter. *Purchased*, 1877.

89185 e. A well-preserved specimen, 22·5 mm. in diameter, figured in fig. 25 *d*, *e*, *f*, p. 69. *Purchased*, 1877.

C. 1791. Two specimens, 5 and 7 mm. in diameter respectively, probably referable to this species.

C. 1792. Six specimens, ranging from 15 to 24 mm. in diameter; and one moiety of a bisected example, 19 mm. in diameter.

C. 1793. Three well-preserved examples, ranging from 9·5 to 13 mm. in diameter, each with a portion of body-chamber.

C. 1794. A similar specimen, 9 mm. in diameter.

C. 1795 k. Sixty-six specimens, ranging in diameter from 4 to 16 mm.

C. 1811 f. Six specimens, ranging from 5·5 to 13 mm. in diameter. The smallest specimen is somewhat inflated, and doubtfully referred to this species.

C. 2119 a. An example, 16 mm. in diameter, and a larger, very much crushed specimen.

C. 4614. Nine fairly well-preserved specimens, ranging in diameter from 7 to 18 mm. *History unknown.*

C. 4615, C. 4617. Eleven specimens, ranging from 7 to 16 mm. in diameter. *History unknown.*

C. 4618. An example, 7 mm. in diameter, belonging either to this species or to *Tornoceras auris*, showing sudden increase in depth of chambers; ? Büdesheim. *History unknown.*

(ii.) *Eibach, near Dillenburg, Nassau.*

C. 4616. A fairly well-preserved but somewhat distorted specimen 55 mm. in diameter; and an imperfect example about 27 mm. in diameter.

Transferred from Museum of Practical Geology.

(iii.) *North-west Hartz.*

C. 4619. An example 15 mm. in diameter; Grund.
History unknown.

C. 4620. A specimen 12 mm. in diameter; Winterberg.
History unknown.

C. 5054. An entirely septate example, 17·5 mm. in diameter, probably referable to this species; Kellwasser, near Altenau. *History unknown.*

(iv.) *Brilon, Westphalia.*

C. 5055. Two examples, 18 and 10 mm. in diameter respectively.
Transferred from Museum of Practical Geology.

(v.) *Gattendorf, near Hof, Bavaria.*

81843. One example, 18 mm. in diameter, labelled "*Goniatites ovatus*" in Münster's handwriting. *History unknown.*

(vi.) *Lower Dunscombe, near Chudleigh, S. Devon.*

C. 1954 b. Compressed but fairly well-preserved specimen, 46 mm. in diameter; body-chamber occupying one-half of outer whorl.

C. 1957 b. Compressed and somewhat distorted example much abraded on one side, its longest diameter 76 mm.

(vii.) *Saltern Cove, near Torquay, S. Devon.*

C. 601 b. Example, 5 mm. in diameter, in matrix.

C. 1753 g. Nine more or less imperfect specimens, ranging in diameter from 5 to 8·5 mm., some showing the suture-line; also several fragments.

C. 1799 b. A specimen, 4·5 mm. in diameter, showing the suture-line.

C. 1824 a. One example, 15 mm. in diameter, in matrix, probably referable to this species.

C. 1960 b. Very imperfect specimen, 5·5 mm. in diameter, probably belonging to this species.

C. 1961 d. Eight examples, ranging from 4 to 11·5 mm. in diameter, several showing the suture-line.

C. 1967 b. Fairly well-preserved specimen, 13 mm. in diameter, showing the suture-line.

Tornoceras Sandbergeri, nom. nov.

1850–56. *Goniatites retrorsus undulatus*, G. & F. Sandberger, Verstein. rhein. Schichtensyst. Nassau, p. 100, pl. x. ff. 17, 17 *a*.

? 1852. *Goniatites retrorsus*, var. *undulatus*, F. A. Roemer, Palæontogr. vol. iii. p. 84, pl. xiii. ff. 1 *a*, *b*.

1873. *Goniatites undulatus*, E. Kayser, Zeitschr. deutsch. geol. Gesell. vol. xxv. p. 621.

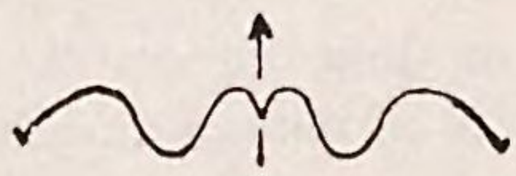
1884. *Tornoceras auris* (pars), A. Hyatt, Proc. Boston Soc. Nat. Hist. vol. xxii. p. 320.

1887. *Goniatites* (*Tornoceras*) *undulatus*, Frech, Zeitschr. deutsch. geol. Gesell. vol. xxxix. p. 428.

[*Not* 1841. *Goniatites undulatus*, T. Brown, Trans. Manchester Geol. Soc. vol. i. p. 213, pl. vii. ff. 1–5; 1883. *Goniatites undulatus*, A. v. Koenen, Neues Jahrb. ii. p. 171.]

Sp. Char. Shell somewhat compressed; greatest thickness at the subangular margin of the umbilical depression, about three-sevenths of the diameter; height of outer whorl a little more than one-half of the diameter of the shell. Whorls (? number); inclusion almost complete; umbilicus very small, almost closed, its sides sloping. Whorl elongate-oval in section, somewhat higher than wide; indented to about two-sevenths of its height by the preceding whorl; periphery feebly convex, somewhat flattened; sides feebly convex, distinctly flattened near the periphery; inner area sloping towards the umbilicus. Body-chamber occupying three-fourths of a whorl; aperture not seen. Chambers rather shallow; suture-line as in fig. 49. Test ornamented with lines of growth

Fig. 49.



Suture-line of *Tornoceras Sandbergeri*, Foord & Crick; somewhat enlarged. After Sandberger.

which are falciform on the lateral area and have their concavity directed forward, they are projected forward near the edge of the periphery, and on the periphery form a deep sinus having its concavity directed forward.

The lateral grooves, flattened periphery, and character of the ornaments distinguish this species from *T. simplex*; the fineness and direction of the growth-lines serve to separate this species from *T. auris*.

The name *undulatus* being preoccupied by Brown in 1841, we have designated this species *T. Sandbergeri*.

Size. Shell attaining a diameter of rather more than 20 mm.

Form. & Loc. Upper Devonian: Büdesheim, Eifel; Saltern Cove, near Torquay, South Devon.

The specimens here referred to this species were presented by John Edward Lee, Esq., 1885.

(i.) *Büdesheim, Eifel.*

C. 1793 a. One example, 15 mm. in diameter.

C. 1795 m. Four specimens, ranging from 7 to 21 mm. in diameter.

(ii.) *Saltern Cove, near Torquay, S. Devon.*

C. 1961 e. Three imperfect specimens, ranging in diameter from 8 to 12 mm., probably belonging to this species.

Tornoceras planidorsatum (G. Münster).

1839. *Goniatites planidorsatus*, G. Münster, Beiträge zur Petrefactenkunde, i. p. 21, pl. iii. ff. 7 *a*, *b*, *c*.
1842. *Goniatites cinctus*, G. Münster, ibid. v. p. 127, pl. xii. f. 7 (*fide* Gümbel).
1843. *Goniatites planidorsatus*, G. Münster, ibid. i. 2nd ed. p. 47, pl. iii. ff. 7 *a*, *b*, *c*.
1850. *Aganides planidorsatus*, A. d'Orbigny, Prod. de Paléont. stratigr. vol. i. p. 60.
1852. *Ammonites* (*Goniatites*) *planidorsatus*, C. G. Giebel, Fauna der Vorwelt, vol. iii. p. 745.
1853. *Goniatites planidorsatus* (pars), H. B. Geinitz, Verstein. Grauwackenform. Sachsen, pt. ii. p. 39, pl. xi. ff. 4 (? 5) (*not* f. 6).
1862. *Goniatites planidorsatus*, C. W. Gümbel, Neues Jahrb. p. 319, pl. v. f. 19.
1873. *Goniatites planidorsatus*, E. Kayser, Zeitschr. deutsch. geol. Gesell. vol. xxv. p. 627, pl. xix. ff. 2 *a–f*.
1883. *Goniatites planidorsatus*, A. von Koenen, Neues Jahrb. ii. p. 171.
1887. *Goniatites* (*Tornoceras*) *planidorsatus*, F. Frech, Zeitschr. deutsch. geol. Gesell. vol. xxxix. pp. 371, 439.

Sp. Char. Shell flat, much compressed, lenticular; greatest thickness near the edge of the umbilicus, from one-third to one-fourth of the diameter; height of outer whorl about one-half of the diameter of the shell. Whorls (? number); inclusion about two-thirds; umbilicus narrow, open, exposing the edges of the inner whorls. Whorl sublanceolate in section; indented to from one-half to one-third of its height by the preceding whorl; periphery narrow, slightly concave, bounded on either side by a sharp ridge;

sides flattened, slightly concave near the periphery, the rest of the lateral area slightly convex; inner area imperfectly defined, convex, sloping towards the umbilicus. Body-chamber occupying more than half a whorl; aperture with a sinus at the middle of each lateral area, probably also with a peripheral sinus. Chambers very shallow; suture-line as in fig. 50. Test ornamented with fine lines of growth,

Fig. 50.

Suture-line of *Tornoceras planidorsatum* (Münster). After Kayser.

which cross the lateral area in a feebly sigmoid curve and on the periphery form imbricating, strongly-curved lines, having their concavity directed forward.

This species bears some resemblance to *Tornoceras auris*, but the latter is always thicker, more involute, with a narrower and deeper umbilicus, with more convex sides and periphery, the periphery never concave nor bounded on either side by a sharp ridge, the lines of growth less falciform, the chambers shallower, and the suture-line different.

In general form the present species is not unlike *Tornoceras subundulatum*, but it has a different suture-line.

Size. Gümbel (*l. c.* ff. 2 *a*, *b*) figures an example 32·5 mm. in diameter.

Form. & Loc. Upper Devonian (Clymenien-Kalk): Schübelhammer, Bavaria.

81909. One somewhat imperfect example, 15 mm. in diameter, partly imbedded in matrix, labelled "*Goniatites planidorsatus*" in Münster's handwriting. *History unknown.*

Tornoceras subundulatum, Frech.

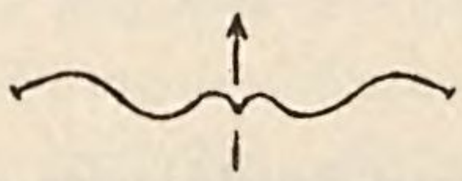
1883. *Goniatites undulatus*, A. von Koenen, Neues Jahrb. ii. p. 171. (*Not* G. & F. Sandberger.)

1887. *Goniatites* (*Tornoceras*) *subundulatus*, F. Frech, Zeitschr. deutsch. geol. Gesell. vol. xxxix. pp. 371, 388, 464, woodc.

Sp. Char. Shell compressed, lenticular; greatest thickness at a short distance from the umbilicus, about one-third of the diameter; height of outer whorl rather more than one-half of the diameter of the shell. Whorls (? number); inclusion three-fourths; umbilicus about one-sixth of the diameter of the shell in width, shallow, exposing the edges of the inner whorls. Whorl lanceolate in section,

much higher than wide; indented to two-fifths of its height by the preceding whorl; periphery narrowly rounded, somewhat flattened, becoming on the body-chamber (in casts) slightly concave; sides flattened, very slightly convex, bearing near the periphery a shallow longitudinal groove; inner area narrow, sloping towards the umbilicus, moderately well-defined. Body-chamber occupying half a whorl. Chambers moderately deep, becoming very shallow in the latter part of the septate portion; suture-line as in fig. 51. Test ornamented with simple, forwardly-inclined striæ, which cross the

Fig. 51.



Suture-line of *Tornoceras subundulatum*, Frech; traced from specimen in the Collection and enlarged.

lateral area in a simple curve having its concavity directed forward, bend abruptly backwards at the shallow longitudinal groove near the periphery, and cross the periphery in a deep linguiform sinus having its concavity directed forward; casts show also faint traces of longitudinal lines.

Resembles in general form *Tornoceras Sandbergeri*, but has a suture-line like that of *Tornoc. circumflexum*.

Size. A specimen in the Collection wanting the body-chamber has a diameter of about 15 mm.

Form. & Loc. Upper Devonian: Vailhan (Hérault), France.

C. 4627. Four examples, ranging from 10 to 15·5 mm. in diameter. In all the specimens the peripheral lobe is a little on one side or other of the median line. Locality not recorded.

History unknown.

C. 4790. One specimen, 8·5 mm. in diameter, having a portion of the body-chamber preserved, and the peripheral lobe also not quite median; Vailhan (Hérault), France.

Purchased, 1894.

Tornoceras subundulatum, var. **falcata,** F. Frech.

1887. *Goniatites* (*Tornoceras*) *subundulatus*, var. *falcata*, F. Frech, Zeitschr. deutsch. geol. Gesell. vol. xxxix. p. 465.

Differs from the typical species in being less compressed and in having deeply impressed falciform ribs on the lateral area (usually

absent on the body-chamber), a serrated and more rounded periphery, a very much smaller umbilicus, and the suture-line as in fig. 52.

Fig. 52.

Suture-line of *Tornoceras subundulatum*, var. *falcata*, Frech. Drawn from the specimen in the Collection, and enlarged.

Form. & Loc. Upper Devonian: Vailhan (Hérault), France.

C. 4791. Entirely septate example, 8 mm. in diameter.

Purchased, 1894.

Tornoceras circumflexiferum (G. & F. Sandberger).

1850–56. *Goniatites circumflexifer*, G. & F. Sandberger, Verstein. rhein. Schichtensyst. Nassau, p. 111, pl. xi. ff. 8, 8 *a–c*.
1852. *Goniatites circumflexifer*, F. A. Römer, Beitr. geol. Kenntn. nordwestl. Harzgeb. ii. p. 80, pl. xii. ff. 22 *a–d*.
1876. *Goniatites circumflexifer*, F. Maurer, Neues Jahrb. p. 825.
1884. *Anarcestes circumflexifer*, A. Hyatt, Proc. Boston Soc. Nat. Hist. p. 310.
1889. *Goniatites circumflexifer*, F. Sandberger, Jahrb. Nassau Ver. Nat. p. 76.
1890. *Goniatites circumflexifer*?, G. F. Whidborne, Devon. Fauna S. England (Mon. Palæontogr. Soc.), pt. ii. p. 71, pl. vi. f. 17.
1895. *Tornoceras circumflexifer*, E. Holzapfel, Abhandl. d. k. Preuss. geol. Landesanst., n. f. Heft xvi. p. 85, pl. iv. f. 6; pl. vii. f. 7.

Sp. Char. Shell (cast) thick, inflated; greatest thickness at the edge of the umbilicus, about one-half of the diameter; height of outer whorl about one-half of the diameter of the shell. Whorls four or five; inclusion almost complete; umbilicus about one-

Fig. 53.

Suture-line of *Tornoceras circumflexiferum* (G. & F. Sandberger). After Sandberger.

sixth of the diameter of the shell in width, deep, only just exposing the edges of the inner whorls. Whorl semi-elliptical in section, a little wider than high; indented to nearly one-half of its height by the preceding whorl; periphery somewhat broadly convex; sides convex; inner area steep, almost perpendicular,

convex. Length of body-chamber unknown. Chambers of medium depth; suture-line as in fig. 53. Test unknown; internal casts with very obscure longitudinal grooves, also with indistinct broad transverse folds in the umbilical region.

Closely allied to *Goniatites micromphalus*, F. A. Roemer (Palæontogr. vol. iii. p. 19, pl. iii. ff. 30 *a*, *b*, *c*), but the latter is a more inflated shell, has a smaller umbilicus and a slightly different suture-line.

The suture-line of the present species is almost identical with that of *Goniatites retrorsus circumflexus*, G. & F. Sandberger (Verstein. rhein. Schichtensyst. Nassau, p. 112, pl. x. f. 9 *c*).

Size. Shell attaining a diameter of about 20 mm.

Form. & Loc. Lower Devonian (Wissenbach-schiefer): Clausthal, N.W. Hartz. (? Middle Devonian: Barton, S. Devon.)

C. 4628. Three fairly well-preserved specimens, 16·5, 17, and 18·5 mm. in diameter respectively; the smallest example exhibiting a portion of the body-chamber, the others being entirely septate. Clausthal, N.W. Hartz.

History unknown.

73810. Specimen figured by Whidborne (*loc. cit.*); Barton, S. Devon. This specimen does not exhibit any trace of the suture-line, and is therefore referred with doubt to this species.

History unknown.

Tornoceras ? aratum (Whidborne).

1889. *Goniatites aratus*, G. F. Whidborne, Geol. Mag. [3] vol. vi. p. 29.

1890. *Goniatites aratus*, G. F. Whidborne, Devon. Fauna S. England, (Mon. Pal. Soc.), pt. ii. p. 66, pl. vi. ff. 16, 16 *a*.

Sp. Char. Shell discoidal, flattened; greatest thickness close to the umbilicus, about two-fifths of the diameter; height of outer whorl rather more than half the diameter of the shell. Whorls few; inclusion almost complete; umbilicus rather small, trochiform. Whorl elongate-oval in section, higher than wide, indented to two-fifths of its height by the preceding whorl; periphery convex; sides flattened, slightly concave near the umbilicus, marked by four deeply impressed angulated sulci. [Body-chamber and septa unknown.] Test smooth (?).

Holzapfel [1] regards this species as a synonymn of *Tornoceras Brilonense* (Beyrich), Kayser sp.[2]

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[1] Abhandl. d. k. Preuss. geol. Landesanst. n. f. Heft xvi. p. 102 (1895).

[2] Zeitschr. deutsch. geol. Gesell., 1872, p. 664, pl. xxiv. f. 2.

Size. Shell attaining a diameter of 26 mm., with a thickness of 10 mm.

Form. & Loc. Middle Devonian: Barton, Torquay, Devon.

C. 1802 a. Specimen figured by Whidborne, *op. cit.* pl. vi. ff. 16, 16 *a*. In the explanation of pl. vi., Mr. Whidborne gives the locality of this specimen as Lummaton.

Presented by John Edward Lee, Esq., 1885.

C. 1802 b. An imperfect example 16 mm. in diameter.

Presented by John Edward Lee, Esq., 1885.

Tornoceras Hughesii (Whidborne).

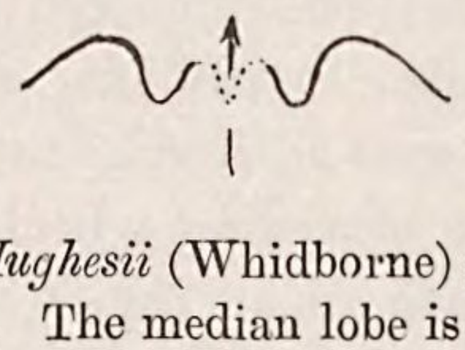
1889. *Goniatites Hughesii* (pars), G. F. Whidborne, Geol. Mag. [3] vol. vi. p. 29.

1890. *Goniatites Hughesii* (pars), G. F. Whidborne, Devon. Fauna S. England (Mon. Pal. Soc,), pt. ii. p. 69, pl. vi. f. 2 (*not* ff. 1, 1 *a*, 2 *a*, 3).

1895. *Tornoceras simplex* (pars), E. Holzapfel, Abhandl. d. k. Preuss. geol. Landesanst. n. f. Heft xvi. p. 95.

Sp. Char. Shell (cast) discoidal, flattened, involute; greatest thickness at the margin of the umbilicus, rather more than one-quarter of the diameter; height of outer whorl three-fifths of the diameter of the shell. Umbilicus very minute, possibly closed. Whorl subtriangular in section, higher than wide, indented to half its height by the preceding whorl; periphery convex; sides convex near the peripheral area, but slightly concave near the inner margin; inner area sloping. Length of body-chamber unknown. Chambers rather shallow. Suture-line (fig. 54): lateral saddle

Fig. 54.



Suture-line of *Tornoceras Hughesii* (Whidborne); drawn from the type and reduced. The median lobe is restored.

somewhat prominent, occupying rather more than the inner half of the lateral area, its outer boundary being almost parallel to the periphery; lateral lobe semi-elliptical, somewhat deep, narrower than the lateral saddle; rest of the suture-line unknown. At a point distant from the umbilicus about two-thirds of the height of

the whorl succeeding suture-lines are almost in contact. Test not seen.

Size. Shell (cast) attaining a diameter of 55 mm., with a thickness of about 21 mm.

Form. & Loc. Middle Devonian : Lummaton, S. Devon.

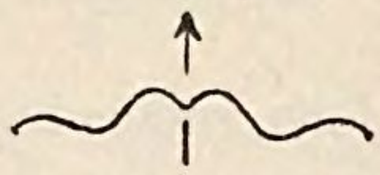
C. 1528 a. Specimen figured by Mr. Whidborne, *op. cit.* pl. vi. f. 2.
Presented by E. B. Luxmore, Esq., 1885.

Tornoceras psittacinum (Whidborne).

1889. *Goniatites psittacinus*, G. F. Whidborne, Geol. Mag. [3] vol. vi. p. 29.
1890. *Goniatites psittacinus*, G. F. Whidborne, Devon. Fauna S. England (Mon. Pal. Soc.), pt. ii. p. 72, pl. vi. ff. 9–13.
1895. *Tornoceras psittacinum*, E. Holzapfel, Abhandl. d. k. Preuss. geol. Landesanst., n. f. Heft xvi. p. 101, pl. iv. ff. 4, 5, 7 ; pl. vii. f. 6.

Sp. Char. Shell elliptical, somewhat compressed; greatest thickness at about the middle of the lateral area, nearly one-half the diameter; height of outer whorl nearly three-fifths of the diameter of the shell. Whorls apparently few ; umbilicus deep and minute, almost always closed by the margin of the body-whorl. Whorl oval in section, somewhat higher than wide, indented to two-thirds of its height by the preceding whorl ; periphery very convex ; sides flattened near the umbilicus, convex near the periphery. Body-chamber (? length). Suture-line as in fig. 55. Test apparently smooth.

Fig. 55.



Suture-line of *Tornoceras psittacinum*.
After Whidborne.

Size. Shell attaining a diameter of 45 mm., with a thickness of 19 mm.

Form. & Loc. Middle Devonian : Wolborough, S. Devon.

36623. Imperfect specimen, 20 mm. in diameter. *Purchased*, 1857.

C. 1741. An example on weathered surface of matrix about 26 mm. in diameter. *Presented by John Edward Lee, Esq.*, 1885.

C. 1804. Two specimens, one (19 mm. in diameter) showing the suture-line, the other (13 mm. in diameter) in matrix.
Presented by John Edward Lee, Esq., 1885.

Tornoceras Whidbornei, sp. nov.

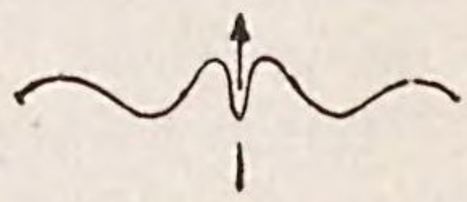
1889. *Goniatites Hughesii* (pars), G. F. Whidborne, Geol. Mag. [3] vol. vi. p. 29.

1890. *Goniatites Hughesii* (pars), G. F. Whidborne, Devon. Fauna S. England (Mon. Pal. Soc.), pt. ii. p. 69, pl. vi. f. 3 (*not* ff. 1, 1 *a*, 2, 2 *a*).

1895. *Tornoceras simplex* (pars), E. Holzapfel, Abhandl. d. k. Preuss. geol. Landesanst., n. f. Heft xvi. p. 95.

Sp. Char. Shell (cast) flattened, involute, somewhat elliptical; greatest thickness close to the umbilicus, rather more than one-third of the diameter; height of outer whorl three-fifths of the diameter of the shell. Whorls (? number); inclusion complete; umbilicus closed by outer whorl. Whorl subelliptical in section, higher than wide, truncated at the umbilicus; indented to nearly half its height by the preceding whorl; periphery rounded; sides feebly convex. Length of body-chamber not known; aperture expanding laterally, thickened near the umbilicus. Chambers, measured at the middle of the lateral area, about one-fifth of the corresponding ventro-dorsal diameter in depth. Suture-line (fig. 56) simple; lateral saddle low, broad, extending across rather more than half

Fig. 56.



Suture-line of *Tornoceras Whidbornei*; traced from type, completed and reduced.

the lateral area; lateral lobe somewhat narrower, occupying the remainder of the lateral area; external saddle rounded; external lobe narrow, funnel-shaped, extending backward half the distance between the septa. Test not seen. Surface of cast covered with fine transverse epidermids.

Size. Shell (cast) attaining a diameter of 53 mm., with a thickness of about 20 mm.

Form. & Loc. Middle Devonian: Lummaton, S. Devon.

C. 1528 b. Type-specimen, figured by Whidborne, *op. cit.* pl. vi. f. 3.
Presented by E. B. Luxmore, Esq., 1885.

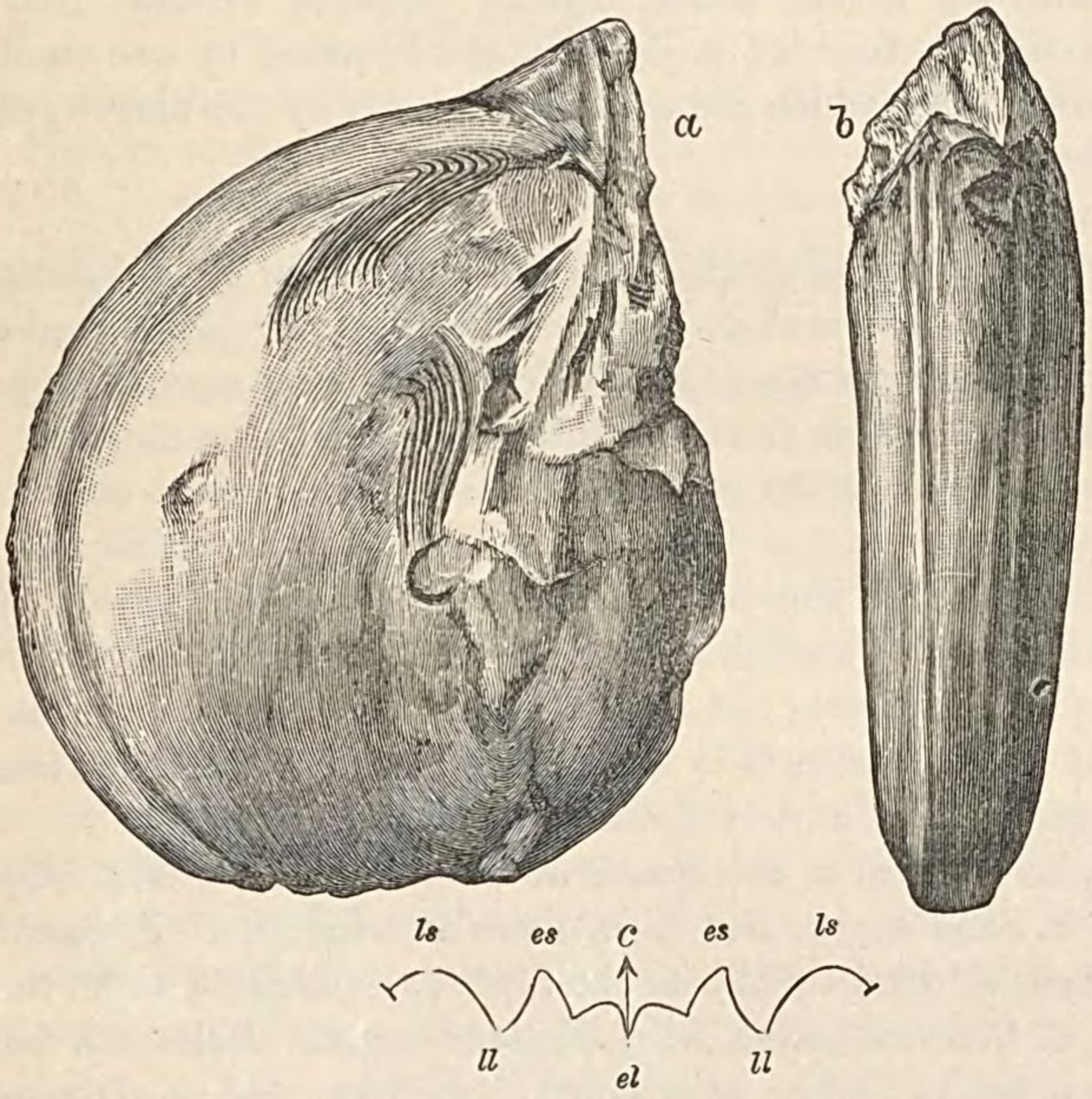
Genus **MAENECERAS,** Hyatt[1].

Syn. *Goniatites,* G. & F. Sandberger, 1850–56[2] (pars), et auct.; *Ammonites,* C. G. Giebel, 1852[3] (pars).

Type[4]. *Goniatites terebratus,* G. & F. Sandberger, Verstein. rhein. Schichtensyst. Nassau, 1850–56, p. 55, pl. v. ff. 3 *a–d.*

Gen. Char. Shell discoidal, usually involute, seldom without um-

Fig. 57.



Maeneceras terebratum.—*a,* lateral view, showing the spiral groove near the periphery and some of the ornaments of the shell: *b,* peripheral view: *c,* suture-line—*el,* peripheral, external or outer lobe; *es,* peripheral, external or outer saddle; *ll,* lateral lobe; *ls,* lateral saddle.—Figures *a* and *b* are drawn from a specimen in the British Museum (No. C. 1843); *c* is copied from G. & F. Sandberger, Verst. rhein. Schichtensyst. Nassau, 1850–56, pl. v. f. 3 *c.* Natural size.

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[1] Proc. Boston Soc. Nat. Hist. vol. xxii. 1884, p. 321.

[2] Verstein. rhein. Schichtensyst. Nassau, p. 55.

[3] Fauna der Vorwelt, vol. iii. pt. i. p. 452.

[4] Hyatt regarded *Goniatites acutolateralis,* G. & F. Sandberger (Verstein. rhein. Schichtensyst. Nassau, 1850–56, p. 98, pl. vi. ff. 1, 1 *a, b*), which he considered to be the adult of *Goniatites terebratus,* as the type of his genus; but Holzapfel points out that the two forms are specifically distinct, and since the figured examples of *G. terebratus* show all the characters of the species, which is not the case with *G. acutolateralis,* he selects the former as the type of the genus.

bilicus, mostly with a narrow and deep step-like umbilicus with sharp edges, with a narrowly rounded and somewhat flattened periphery having a spiral groove on either side; the test ornamented with lines of growth which indicate the presence of long narrow lateral lappets at the border of the aperture. Body-chamber long. Suture-line with a deep and wide infundibuliform external lobe, the broad external saddle unsymmetrically divided by a feeble shallow lobe, the lateral lobe pointed and usually not quite symmetrical, the lateral saddle broadly rounded, internal lobe wide, bottle-shaped, rounded posteriorly and bounded by two similar but shallower lobes which are separated from it by two narrow, rounded saddles.

Devonian.

Remarks. Young shells have the suture-line of *Agoniatites*, but the external lobe is shallower and the external saddle broader. As the shell increases the saddle widens, and then a small depression appears in it which develops into a lobe. The development of the suture-line points to a descent from *Agoniatites*, which genus agrees also in the possession of a spiral furrow on either side of the periphery. The general appearance, the degree of involution, and the form of the umbilicus in the type suggest affinity with some forms of *Agoniatites*, but in that genus the body-chamber is short, whilst in *Maeneceras* it is long. Further observations are necessary in order to fix definitely the descent of *Maeneceras*.

Hyatt referred to this genus *Gon. bifer*, Phillips, *Gon. delphinus*, G. & F. Sandberger, and *Gon. acutolateralis*, G. & F. Sandberger. The last, selected by him as the type, he considered to be the adult form of *Gon. terebratus*, G. & F. Sandberger. Holzapfel, however, regards the two forms as specifically distinct; and since the example of *G. terebratus* figured by Sandberger shows the characters of the species, while the imperfect example of *G. acutolateralis* does not, he regards the former as the type of the genus. With respect to *G. bifer*, Phillips, Holzapfel points out that it differs from *G. terebratus* both in the form of the shell and also in the character of the suture-line, the latter suggesting its derivation not from *Agoniatites* but rather from *Brancoceras*, and this view is supported by the form of the shell and its constrictions. Holzapfel regards it as transitional between *Brancoceras* and *Sporadoceras*, a relationship which is in accord with its occurrence in the *Clymenia*-beds.

G. & F. Sandberger did not know, or, at least, did not figure the suture-line of their *G. delphinus*, but the figure of it given by Kayser shows that the species does not belong to *Maeneceras*. It has a *Lobites*-like body-chamber, and belongs to the genus which Frech

has appropriately called *Prolobites*, a name, however, that had already been suggested by Karpinsky [1] for this species.

Holzapfel therefore restricts Hyatt's genus to embrace *G. terebratus*, Sandberger; *G. excavatus*, Phillips (1842 not 1836); *G. Decheni*, Kayser; and *M. tenue*, Holz. Hence the genus is confined to the Upper Middle Devonian.

Maeneceras terebratum (G. & F. Sandberger).

(Fig. 57, p. 121.)

? 1850. *Goniatites retrorsus*, var. *undulatus*, F. A. Roemer, Beitr. geol. Kenntn. nordwestl. Harzgeb. ii. p. 84, pl. xiii. ff. 1 *a*, *b*.

1850–56. *Goniatites terebratus*, G. & F. Sandberger, Verstein. rhein. Schichtensyst. Nassau, p. 55, pl. v. ff. 3, 3 *a–d*.

1852. *Ammonites terebratus*, C. G. Giebel, Fauna der Vorwelt, vol. iii. pt. i. p. 452.

1860. *Goniatites terebratus*, F. A. Roemer, Beitr. geol. Kenntn. nordwestl. Harzgeb. v. p. 159, pl. xxiv. ff. 4 *a*, *b*, *c*.

1884. *Maeneceras terebratum*, A. Hyatt, Proc. Boston Soc. Nat. Hist. vol. xxii. p. 321.

1895. *Maeneceras terebratum*, E. Holzapfel, Abhandl. d. k. Preuss. geol. Landesanst., n. f. Heft xvi. p. 107, pl. iv. ff. 14, 18; pl. vi. ff. 6, 7, 9.

Sp. Char. Shell discoidal, compressed, involute, spherical in the young; greatest thickness at about the middle of the lateral area, about two-sevenths of the diameter; height of the outer whorl about four-sevenths of the diameter of the shell. Whorls seven to eight; inclusion nearly complete; umbilicus small, with sharp rather prominent edges. Whorl (in adult) elongate-oval in section, about twice as high as wide; indented to about one-half of its height by the preceding whorl; periphery flattened, feebly convex, with subangular borders; sides feebly convex over the greater part of their area, depressed and slightly concave near the umbilicus, with a broad shallow groove close to the peripheral margin; inner margin very narrow. Body-chamber occupying at least one and a quarter whorls; peristome sigmoidal on the sides, projected considerably forward near the periphery, with a deep linguiform sinus on the periphery. Chambers rather shallow; suture-line as in fig. 57 *c* (p. 121). Test ornamented with lines of growth, which are sigmoidal on the lateral area, project considerably forward near the periphery, and form a deep linguiform sinus on the periphery. Initial-chamber oval, very small, and indistinctly marked off from

[1] Bull. Com. géol. St. Pétersbourg, vol. iv. 1885, no. 7, p. 336.

the rest of the shell. 'Wrinkle-layer' consisting of fine anastomosing rugæ having an almost radial direction on the lateral area.

Size. Shell attaining a diameter of about 60 mm.

Form. & Loc. Middle Devonian: Adorf, Waldeck; Polsterberg, N.W. Hartz (Stringocephalen-Kalk).

C. 1842 b. Somewhat elliptical example, about 28 mm. in its longer diameter, exhibiting some of the ornaments of the test and a portion of the 'wrinkle-layer'; Adorf.

Presented by John Edward Lee, Esq., 1885.

C. 1843. An example, 58 mm. in diameter, showing the 'wrinkle-layer,' a portion of the sculpture of the test, and part of the mouth-border; Adorf.

Presented by John Edward Lee, Esq., 1885.

C 5053. An elliptical imperfect specimen, 45 mm. in diameter; Polsterberg. *History unknown.*

Maeneceras molarium (Whidborne).

1841. *Goniatites excavatus*, J. Phillips, Pal. Foss. Cornwall, Devon & West Somerset (Mem. Geol. Surv.), p. 121, pl. l. f. 232 *a*, *b*; pl. lx. f. 232 (*not* J. Phillips, Geol. Yorks. pt. ii. 1839, p. 235, pl. xix. ff. 33, 35).

1843. *Goniatites excavatus* (pars), J. Morris, Cat. Brit. Foss. p. 179.

? 1850. *Goniatites discus*, F. A. Römer, Beitr. geol. Kennt. nordwestl. Harzgeb. pt. i. p. 39, pl. vi. ff. 7 *a*, *b*, *c* (juv.).

1852. *Ammonites reticulatus* (pars), C. G. Giebel, Fauna der Vorwelt, vol. iii. p. 471.

1854. *Goniatites excavatus* (pars), J. Morris, Cat. Brit. Foss. 2nd ed. p. 303.

1888. *Goniatites excavatus*, R. Etheridge, Brit. Foss. vol. i. Palæozoic, p. 167.

1890. *Goniatites molarius*, G. F. Whidborne, Devon. Fauna S. England (Mon. Pal. Soc.), pt. ii. p. 64, pl. v. ff. 11, 11 *a*; pl. vi. ff. 4, 4 *a*, 6, 6 *a*.

? 1895. *Maeneceras excavatum*, E. Holzapfel, Abhandl. d. k. Preuss. geol. Landesanst., n. f. Heft xvi. p. 112, pl. iv. ff. 17, 17 *a–c*.

Sp. Char. Shell discoidal, with nearly parallel sides; greatest thickness at about the middle of the lateral area, about three-tenths of the diameter; height of outer whorl about three-sevenths of the diameter of the shell. Whorls five or more, almost completely involute; umbilicus about one-quarter of the diameter of the shell in width, very deep, exposing the angular edges of the inner whorls. Whorl subquadrate in section, higher than wide, indented to more than half its height by the preceding whorl; periphery flattened,

about half the corresponding ventro-dorsal diameter in width, sometimes defined by lateral excavations; inner two-thirds of the sides flat and nearly parallel, the outer third convex. Suture-line as in fig. 58. Test apparently smooth.

Fig. 58.

Suture-line of *Maeneceras molarium*. Drawn from a specimen in the Collection (No. 30306 *a*).

Size. Shell attaining a diameter of 50 mm., with a thickness of 15 mm.

Form. & Loc. Middle Devonian: Wolborough, S. Devon.

30306 a. Specimen figured by Mr. Whidborne, *op. cit.* pl. vi. ff. 4, 4 *a*. The siphonal lobe appears to be not quite correctly drawn in Mr. Whidborne's figure. *Purchased*, 1852.

C. 1803 a, b. Two examples, one of which (*a*) is the type-specimen described and figured by Phillips, *op. cit.* p. 121, pl. l. ff. 232 *a*, *b*. *Presented by John Edward Lee, Esq.*, 1885.

Maeneceras intermedium, sp. nov.

1841. *Goniatites globosus*, J. Phillips, Pal. Foss. Cornwall, Devon, & West Somerset (Mem. Geol. Surv.), p. 120, pl. l. f. 231.

1890. *Goniatites globosus* (pars), G. F. Whidborne, Devon. Fauna S. England (Mon. Palæontogr. Soc.), pt. ii. p. 67, pl. vi. ff. 5, 5 *a* (*not* pl. v. ff. 12, 12 *a*, *b*).

Sp. Char. Shell subglobose, umbilicated, somewhat compressed; greatest thickness at the umbilical margin, rather more than one-half of the diameter of the shell; height of outer whorl about two-fifths of the diameter of the shell. Whorls about six; inclusion nearly complete; umbilicus with angular margin, about three-tenths of the diameter of the shell in width, exposing the edges of the inner whorls. Whorl semi-elliptical in section, rather wider than high; indented to about one-half of its height by the preceding whorl; periphery broadly convex, somewhat flattened, its boundaries imperfectly defined; sides flattened, feebly convex, inner margin narrow, sharply marked off from the lateral area, almost perpendicular to the plane of symmetry. Length of body-chamber not known. Suture-line and test not seen.

Although the suture-line cannot be made out, there can be but little doubt that the species is referable to Hyatt's genus *Maeneceras*.

Size. Shell attaining a diameter of 20 mm.

Form. & Loc. Middle Devonian : Wolborough, S. Devon.

30306 b, c. Two somewhat elliptical examples, 20 and 12·5 mm. in diameter respectively. *Purchased*, 1852.

Maeneceras apertum, sp. nov.

1890. *Goniatites globosus* (pars), G. F. Whidborne, Devon. Fauna S. England (Mon. Palæontogr. Soc.), pt. ii. p. 67, pl. v. ff. 12, 12 *a*, *b* (*not* pl. vi. ff. 5, 5 *a*).

Sp. Char. Shell subglobose, rather widely umbilicated; greatest thickness near the margin of the umbilicus, about five-sevenths of the diameter of the shell; height of outer whorl about one-third of the diameter of the shell. Whorls about six; involution three-fourths; umbilicus rather more than one-third of the diameter of the shell in width, deep, exposing the subangular edges of the inner whorls. Whorl subtrapezoidal in section, wider than high;

Fig. 59.

Suture-line of *Maeneceras apertum*, traced from the type in the Museum of Practical Geology.

indented to about one-half of its height by the preceding whorl; periphery broad, feebly convex, slightly flattened, its margins obtusely angular; sides feebly convex; somewhat flattened, converging towards the periphery; inner area very narrow, convex, perpendicular to the plane of symmetry. Body-chamber not seen. Chambers (? depth); suture-line as in fig. 59. Test not seen.

Dimensions. Diameter of shell 18 mm.; width of umbilicus 6·5 mm.; height of outer whorl 6·5 mm.; ditto above preceding whorl 3 mm.; thickness of ditto 10·5 mm.

Remarks. The type is in the Museum of Practical Geology, and was figured by Mr. Whidborne (*l. c.* pl. v. f. 12) under the name *Goniatites globosus*, Münster?. It is labelled "Newton Bushel," but Mr. Whidborne gives "Wolborough" as the locality. It is a little elliptical; the suture-line can be seen at the anterior extremity of the specimen, but this is somewhat abraded, so that the suture-line cannot be made out quite accurately, but it seems to have had the form here indicated, a form of suture-line which agrees with

that of some stages of the genus *Maeneceras*. The trivial name is suggested by the wide, open umbilicus.

At first we thought this fossil might be specifically identical with the two specimens in the British Museum Collection (nos. 30306 *b*, *c*) which Mr. Whidborne also referred to *Goniatites globosus*, Münster?, and which we have referred to a new species *Maeneceras intermedium*, but it has a relatively wider umbilicus, is a more inflated shell, and the inclusion is less.

Although the British Museum Collection apparently does not contain an example of this species, it seemed to us desirable to insert the above description.

Form. & Loc. Middle Devonian: Wolborough, S. Devon.

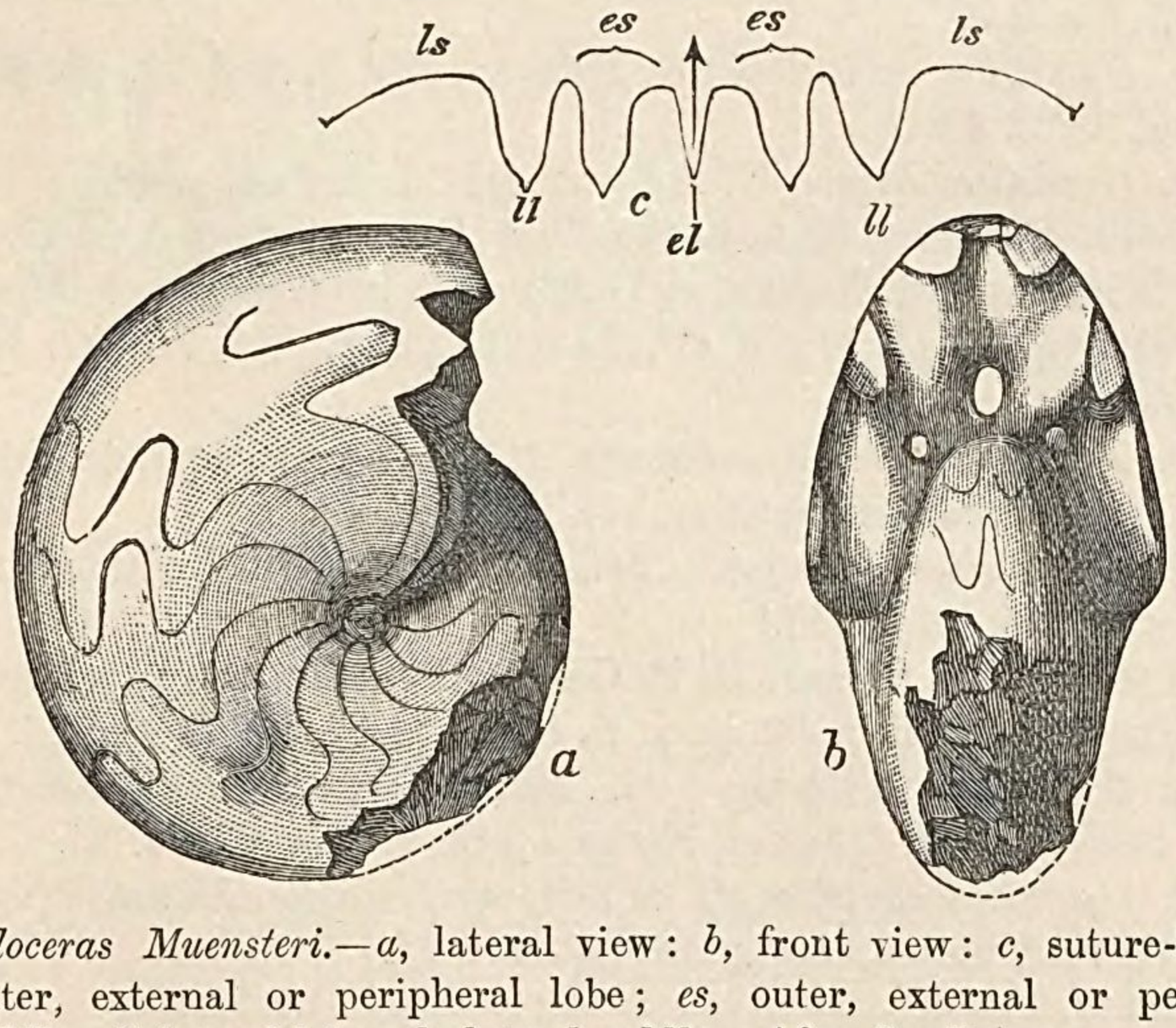
Genus **SPORADOCERAS,** Hyatt[1].

Syn. *Ammonites*, L. v. Buch, 1832[2] (pars), et auct.; *Goniatites*, G. Münster, 1832[3] (pars), et auct.; *Aganides*, A. d'Orbigny, 1850[4] (pars).

Type. *Goniatites bilanceolatus*, G. & F. Sandberger, Verstein. rhein. Schichtensyst. Nassau, 1850–56, p. 71, pl. viii. ff. 11, 11 *a–d* (named *G. bidens* on plate).

Gen. Char. Shell discoidal, somewhat compressed, involute, some-

Fig. 60.



Sporadoceras Muensteri.—*a*, lateral view: *b*, front view: *c*, suture-line—*el*, outer, external or peripheral lobe; *es*, outer, external or peripheral saddle; *ll*, lateral lobe; *ls*, lateral saddle. After Sandberger.

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[1] Proc. Boston Soc. Nat. Hist. vol. xxii. p. 321 (1884).

[2] Abhandl. k. Akad. Wissensch. Berlin, Phys. & Math.-Cl. for 1830, p. 41.

[3] Ueber Planul. & Goniat. p. 25.

[4] Prod. de Paléont. stratigr. vol. i. pp. 58, 59.

times with flattened periphery. Suture-line with infundibuliform external or peripheral lobe, the broad external or peripheral saddle divided by a deep lobe into two narrow saddles, the lateral lobe pointed, and the lateral saddle broadly rounded.

Devonian.

Hyatt referred von Buch's *Ammonites Hoeninghausi* to this genus, but according to Holzapfel[1] this species is the same as the *Goniatites lamellosus* of G. & F. Sandberger, and is therefore referable to Hyatt's *Gephyroceras*.

Sporadoceras Muensteri (v. Buch).

[Fig. 60, p. 127.]

1832. *Ammonites Münsteri*, v. Buch, Abhandl. k. Akad. Wiss. Berlin, Phys. & Math.-Cl. for 1830, p. 41, pl. ii. f. 5 (*not* f. 4)[2].
1832. *Goniatites Münsteri*, G. Münster, Ueber Planul. & Goniat. p. 25, pl. v. ff. 3 *a*, *b*, *c*.
1832. *Goniatites contiguus*, G. Münster, ibid. p. 26, pl. iii. ff. 8 *a*, *b*, *c*.
1832. *Goniatites orbicularis*, G. Münster, ibid. p. 26, pl. v. ff. 4 *a*, *b*, *c*.
1839. *Goniatites Bronnii*, G. Münster, Beitr. zur Petrefactenkunde, i. p. 22 (*not* of Richter, *not* of Klipstein).
1843. *Goniatites Münsteri*, G. Münster, ibid. i. 2nd ed. p. 19, pl. v[a]. ff. 3 *a*, *b*, *c*.
1843. *Goniatites contiguus*, G. Münster, ibid. i. 2nd ed. p. 20, pl. iii[a]. ff. 8 *a*, *b*, *c*.
1843. *Goniatites orbicularis*, G. Münster, ibid. i. 2nd ed. pp. 20 & 48, pl. v[a]. ff. 4 *a*, *b*, *c*.
1843. *Goniatites Bronii*, G. Münster, ibid. i. 2nd ed. p. 48.
1850–56. *Goniatites bilanceolatus*, G. & F. Sandberger, Verstein. rhein. Schichtensyst. Nassau, p. 71, pl. v. f. 2 (*Goniatites? Münsteri*); pl. viii. ff. 11, 11 *a–d* (*G. bidens*); pl. ix. ff. 7, 7 *a* (*G. bilanceolatus*).
1850. *Aganides Bronnii*, *contiguus*, *Münsteri*, *orbicularis*, A. d'Orbigny, Prod. de Paléont. stratigr. vol. i. pp. 58, 59.
1852. *Ammonites descriptus*, *Münsteri*, C. G. Giebel, Fauna der Vorwelt, vol. iii. p. 452.
1853. *Goniatites Bronni*, H. B. Geinitz, Verstein. Grauwackenform. in Sachsen, pt. ii. p. 39, pl. x. ff. 8–10; pl. xi. f. 2 (*not* pl. xi. f. 3).
1862. *Goniatites orbicularis*, G. Münster=*Goniatites Münsteri* (v. Buch), C. W. Gümbel, Neues Jahrb. p. 303, pl. v. f. 24.
1862. *Goniatites contiguus*, G. Münster=*Goniatites Münsteri* (v. Buch), C. W. Gümbel, ibid. p. 303, pl. v. f. 25.

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[1] Abhandl. d. k. Preuss. geol. Landesanst., neue Folge, Heft xvi. 1895, p. 116.

[2] In the explanation of the plate, f. 4 is named *Ammonites Münsteri* instead of *Ammonites Hoeninghausi*.

1862. *Goniatites Bronni*, G. Münster=*Goniatites Münsteri* (v. Buch), C. W. Gümbel, ibid. pp. 304, 322, pl. v. ff. 26–31.
1870. *Goniatites Muensteri*, E. Tietze, Palæontogr. vol. xix. p. 130, pl. xvi. f. 7.
1873. *Goniatites Münsteri*, E. Kayser, Zeitschr. deutsch. geol. Gesell. vol. xxv. p. 610.
1884. *Sporadoceras contiguum*, *Muensteri*, *orbiculare*, *bidens*, *bilanceolatum*, A. Hyatt, Proc. Boston Soc. Nat. Hist. vol. xxii. p. 322.
1887. *Goniatites* (*Sporadoceras*) *Bronni* (=*Münsteri*, auct.), F. Frech, Zeitschr. deutsch. geol. Gesell. vol. xxxix. pp. 372, 447.

Sp. Char. Shell subglobose, more or less compressed; greatest thickness almost close to the umbilicus, rather more than one-half of the diameter of the shell; height of outer whorl about seven-twelfths of the diameter of the shell. Whorls (? number); involution almost complete; umbilicus small, deep. Whorl truncated-oval in section, a little higher than wide; indented to about one-half of its height by the preceding whorl; periphery broadly convex, a little flattened; sides feebly convex, flattened, their innermost portion sloping into the umbilicus without forming any distinct inner area. Body-chamber (? length); chambers rather shallow; suture-line as in fig. 60 *c* (p. 127). Test ornamented with simple lines of growth, which form a very shallow sinus on the periphery. 'Wrinkle-layer' with irregularly curved, anastomosing striæ.

From the imperfect specimens before us we are not able to give a complete diagnosis of the species; the above description is based chiefly on the description and figures of *G. bilanceolatus* given by G. & F. Sandberger.

The Collection contains three specimens labelled in Münster's handwriting "*Goniatites Münsteri*, v. Buch," "*Goniatites contiguus*, Mst.," and "*Goniatites Bronnii*, M.," respectively, but they are too imperfect to enable us to satisfy ourselves as to the identity of these species. We have, however, followed Gümbel, who unites them under von Buch's name, and combines with them also Münster's *Goniatites orbicularis*, but we note that the specimen marked "*Bronnii*" agrees with Münster's description of that species in having no umbilicus.

Frech adopts the trivial name *Bronni*, Münster, for the present species.

Size. Shell attaining a diameter of more than 70 mm.

Form. & Loc.—British. Devonian (derived): Teignmouth, S. Devon.—*Foreign.* Upper Devonian (Clymenien-Kalk): Schübelhammer and Geiser, Bavaria.

27442. A rolled specimen, sectioned and polished, showing the

suture-line; in all probability referable to this species: Teignmouth. *Presented by James Atkins, Esq.*, 1852.

81840. Portion of septate part of an example about 70 mm. in diameter, labelled in Münster's handwriting "*Goniatites Münsteri*, v. Buch," showing the suture-line, which agrees with Münster's figure of that of *G. Münsteri* (Ueber Planul. & Goniat. pl. v. f. 3 *c*); Schübelhammer.
History unknown.

81846. Elliptical specimen, about 28 mm. in diameter, on surface of matrix, labelled in Münster's handwriting "*Goniatites Bronnii*, M.," but not displaying the suture-line; Geiser.
History unknown.

81859. Example, 36 mm. in diameter, much obscured by matrix, labelled "*Goniatites contiguus*, Mst.," in Münster's handwriting; the suture-line agrees with that given by Münster (*op. cit.* pl. iii. f. 8 *c*), but the shell is more compressed than Münster depicts (*op. cit.* pl. iii. ff. 8 *a*, *b*); Schübelhammer. *History unknown.*

Sporadoceras subbilobatum (G. Münster).

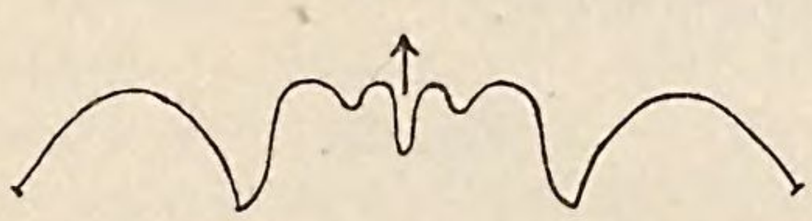
1839. *Goniatites subbilobatus*, G. Münster, Beiträge zur Petrefactenkunde, i. p. 21, pl. xvii. ff. 1 *a–c*.
1840. *Goniatites Ungeri*, G. Münster, ibid. iii. p. 107, pl. xvi. ff. 8 *a–c*.
1843. *Goniatites subbilobatus*, G. Münster, ibid. i. 2nd ed. p. 47, pl. xvii. ff. 1 *a–c*.
1850. *Aganides subbilobatus*, A. d'Orbigny, Prod. de Paléont. stratigr. vol. i. p. 60.
1852. *Ammonites* (*Goniatites*) *subbilobatus*, C. G. Giebel, Fauna der Vorwelt, vol. iii. p. 745.
1862. *Goniatites Ungeri*, G. Münster=*Goniatites subbilobatus*, G. Münster, C. W. Gümbel, Neues Jahrb. pp. 301, 321, pl. v. ff. 20, 21, 22.
1870. *Goniatites subbilobatus*, E. Tietze, Palæontogr. vol. xix. p. 131.
1884. *Brancoceras Ungeri*, A. Hyatt, Proc. Boston Soc. Nat. Hist. vol. xxii. p. 326.
1887. *Goniatites* (*Sporadoceras*) *subbilobatus*, F. Frech, Zeitschr. deutsch. geol. Gesell. vol. xxxix. pp. 372, 447.

Sp. Char. Shell somewhat compressed, involute; greatest thickness near the umbilicus, about three-sevenths of the diameter; height of outer whorl about three-fifths of the diameter of the shell. Whorls (? number); inclusion complete; umbilicus closed, depressed. Whorl oval in section, higher than wide; indented to rather more

than one-half of its height by the preceding whorl; periphery convex, rather broad, continuous with the sides; sides feebly convex, somewhat flattened, depressed at the umbilicus. Length of body-chamber not known. Chambers not very shallow, twelve in a whorl; suture-line as in fig. 61. Test smooth.

The above description is based principally upon Münster's figure; the only representative of this species in the Collection is not well preserved.

Fig. 61.



Suture-line of *Sporadoceras subbilobatum*.
After Gümbel.

Size. Shell attaining a diameter of about 70 mm.
Form. & Loc. Upper Devonian (Clymenien-Kalk): Gattendorf.

81835. Distorted specimen, 72 mm. in diameter, having its surface very much scraped; labelled *Goniatites subbilobatus* in Münster's handwriting. *History unknown*.

Family GLYPHIOCERATIDÆ.

(*Carbonarii*, Beyrich; *Simplices p. p.*, Beyrich; *Genufracti*, Sandberger; *Indivisi*, Bronn.)

Peripheral lobe undivided in the older, divided in the younger forms; outer saddle on the periphery; lateral lobe deep, generally angular; lateral saddle simple or divided by a second lateral lobe. Siphonal-necks short, usually with a forwardly-directed 'collar.'

Genus **BRANCOCERAS**, A. Hyatt [1] (*not* Steinmann) [2].

Syn. *Aganides*, de Montfort, 1808 [3], fide P. Fischer [4]; *Goniatites*, G. Münster, 1832 [5] (pars), et auct.; *Ammonites*, E. Beyrich, 1837 [6] (pars), et auct.; *Prionoceras*, A. Hyatt, 1884 [7] (pars).

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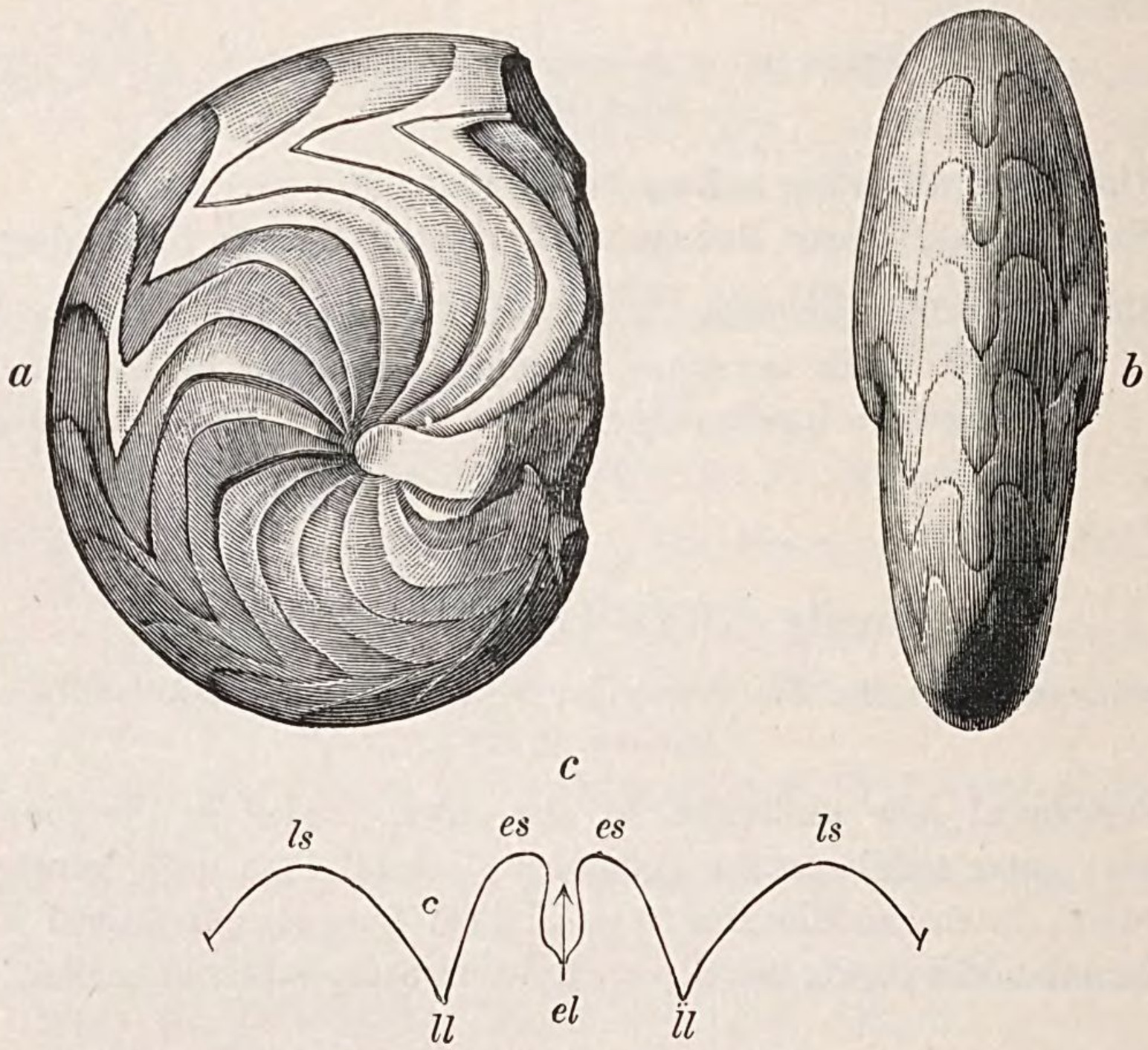
[1] Proc. Boston Soc. Nat. Hist. vol. xxii. 1884, p. 325.
[2] Neues Jahrb. 1881, vol. ii. p. 133.
[3] Conchyliologie systématique, vol. i. p. 30 (1808).
[4] Manuel de Conchyliologie, 1880–87, p. 380.
[5] Ueber Planul. & Goniat. 1832, pp. 23, 24.
[6] Beitr. Kennt. Verstein. rhein. Uebergangsgeb. pt. i. 1837, pp. 31, 43.
[7] Proc. Boston Soc. Nat. Hist. vol. xxii. 1884, p. 328.

Type. *Goniatites Ixion*, J. Hall, Thirteenth Rep. N. York State Cab. Nat. Hist. 1860, p. 125, woodc. ff. 1–3; and Nat. Hist. New York, Pt. VI. Palæont. vol. v. pt. ii. 1879, p. 474, pl. lxxiii. ff. 12–14, pl. lxxiv. f. 12.

Gen. Char. Shell involute, or narrowly umbilicated, more or less inflated, with rounded periphery; suture-line with a deep undivided external (outer or peripheral) lobe, a narrow rounded external saddle, a narrow deep lateral lobe, and a large rounded undivided lateral saddle.

Devonian and Carboniferous.

Fig. 62.



Brancoceras Ixion.—*a*, lateral view of a natural cast from the Goniatite Limestone, Kinderhook group, Rockford, Indiana: *b*, peripheral view of the same: *c*, suture-line of same—*el*, external, outer or peripheral lobe; *es*, external, outer or peripheral saddle; *ll*, lateral lobe; *ls*, lateral saddle. Drawn of about three-fourths of the natural size from a specimen in the British Museum.

Remarks. P. Fischer states that the species figured by de Montfort as the type of his genus *Aganides* is the *Goniatites rotatorius*, de Koninck. If this be so de Montfort's name should supersede Hyatt's *Brancoceras*; but *Aganides*, de Montfort, has been so variously interpreted owing to the uncertainty of the type-species,

that for the present we are disposed to use Hyatt's name for the genus.

Prionoceras was founded by Hyatt on two forms (*Goniatites divisus*, Münster, and *Goniatites Belvalianus*, de Koninck), which he says "differ from *Brancoceras* only in the acuteness of the first pairs of saddles and lobes, and their peculiar pyramidal shape." Gümbel had already shown that all the saddles in the former species are rounded, and referred the species to Münster's "*Goniatites linearis*." Holzapfel agrees with Gümbel as to the character of the suture-line, but not as to the identity of the species with Münster's *G. linearis*, for whilst he regards *G. divisus* as a *Brancoceras*, he states that *G. linearis*, Münster, does not belong to this genus. The same author also points out that de Koninck describes the external saddle of the suture-line of his species as "subangular," not acute, and that this species also is referable to the genus *Brancoceras*.

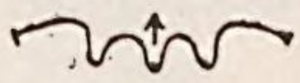
Brancoceras divisum (G. Münster).

1832. *Goniatites divisus*, G. Münster, Ueber Planul. & Goniat. p. 24, pl. iv. ff. 6 *a–d*.
1832. *Goniatites gracilis*, G. Münster, ibid. p. 33.
1837. *Ammonites divisus*, E. Beyrich, Beitr. Kennt. Verstein. rhein. Uebergangsgeb. pt. i. pp. 31, 43.
1839. *Goniatites divisus*, G. Münster, Beitr. zur Petrefactenkunde, i. p. 20.
1839. *Goniatites tripartitus*, G. Münster, ibid. i. p. 20.
1839. *Goniatites gracilis*, G. Münster, ibid. i. p. 31.
1840. *Goniatites tripartitus*, G. Münster, ibid. iii. p. 107.
1842. *Goniatites tripartitus lineatus*, G. Münster, ibid. v. p. 128, pl. xi. ff. 18 *a*, *b*.
1843. *Goniatites divisus*, G. Münster, ibid. i. 2nd ed. pp. 18 & 46, pl. iv.[a] ff. 6 *a-d*.
1843. *Goniatites tripartitus*, G. Münster, ibid. i. 2nd ed. p. 46.
1850. *Aganides divisus*, A. d'Orbigny, Prod. de Paléont. stratigr. vol. i. p. 59.
1850. *Aganides tripartitus*, A. d'Orbigny, ibid. vol. i. p. 61.
1852. *Ammonites retrorsus* (pars), C. G. Giebel, Fauna der Vorwelt, vol. iii. p. 457.
1862. *Goniatites divisus*, G. Münster, = *Goniatites linearis*, G. Münster, C. W. Gümbel, Neues Jahrb. p. 298, pl. v. f. 15.
1862. *Goniatites tripartitus*, G. Münster, = *Goniatites linearis*, G. Münster, C. W. Gümbel, ibid. p. 299, pl. v. f. 16.
1862. *Goniatites gracilis*, G. Münster, = *Goniatites linearis*, G. Münster, C. W. Gümbel, ibid. p. 307.
1884. *Prionoceras divisum*, A. Hyatt, Proc. Boston Soc. Nat. Hist vol. xxii. p. 328.

[*Not* 1880. *Goniatites divisus*, L. G. de Koninck, Faune Calc. Carb. de la Belgique (Ann. Mus. Roy. d'Hist. nat. de Belgique, sér. Paléont. vol. v.), pt. ii. p. 117, pl. xlviii. f. 13.]

Sp. Char. Shell small, ovoid, inflated; greatest thickness at the margin of the umbilicus, about two-thirds of the diameter of the shell; height of outer whorl about four-sevenths of the diameter of the shell. Whorls eight to nine; inclusion complete; umbilicus small in the young, closed in the adult. Whorl semilunate in section, about as wide as high; indented to rather more than one-half of its height by the preceding whorl; periphery broadly rounded; sides convex, somewhat flattened. Length of body-chamber unknown. Chambers fourteen or fifteen to a whorl; suture-line as in fig. 63.

Fig. 63.



Suture-line of *Brancoceras divisum*.
After Gümbel.

Test ornamented with fine, direct, transverse striæ; outer whorl crossed by three simply curved, backwardly directed sulci.

Hyatt made this species the type of his genus *Prionoceras*, pointing out that this genus differed "from *Brancoceras* only in the acuteness of the first pairs of saddles and lobes, and their peculiar pyramidal shape." But Gümbel in 1862 showed that the saddles in this species are rounded; it belongs therefore, as Holzapfel states [1], to the genus *Brancoceras*.

Size. Shell attaining a diameter of about 20 mm.

Form. & Loc. Upper Devonian (Clymenien-Kalk): Schübelhammer, Gattendorf, and Geigen, near Hof, Bavaria.

62507. Specimen, 13·5 mm. in diameter, imbedded in matrix and showing the ornaments of the test; Gattendorf.
Bruckmann Coll.

81837. Two inflated examples, 20 and 15 mm. in diameter respectively, the larger imbedded in matrix, labelled in Münster's handwriting "*Goniatites tripartitus*"; Schübelhammer.
History unknown.

81862. Periphero-lateral aspect of a specimen, 7 mm. in diameter, in matrix, labelled "*Goniatites divisus*" in Münster's handwriting; Geigen, near Hof. *History unknown.*

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[1] Palæont. Abhandl., Dames & Kayser, vol. v. 1 (1889), p. 22.

Brancoceras sulcatum (G. Münster).

1832. *Goniatites sulcatus*, G. Münster, Ueber Planul. & Goniat. p. 23, pl. iii. figs. 7 *a*, *b*, *c*.

1843. *Goniatites sulcatus*, G. Münster, Beiträge zur Petrefactenkunde, i. 2nd ed. p. 18, pl. iii.[a] ff. 7 *a*, *b*, *c*.

1848. *Goniatites sulcatus*, R. Richter, Beitrag zur Paläontologie des Thüringer Waldes, p. 32, pl. iv. ff. 100–112.

1850. *Aganides sulcatus*, A. d'Orbigny, Prod. de Paléont. stratigr. vol. i. p. 60.

1852. *Ammonites retrorsus* (pars), C. G. Giebel, Fauna der Vorwelt, vol. iii. p. 457.

1862. *Goniatites sulcatus*, G. Münster,= *Goniatites linearis*, G. Münster, C. W. Gümbel, Neues Jahrb. p. 298, pl. v. f. 14.

1870. *Goniatites sulcatus*, E. Tietze, Palæontogr. vol. xix. p. 131.

1873. *Goniatites sulcatus*, E. Kayser, Zeitschr. deutsch. geol. Gesell. vol. xxv. p. 614, pl. xix. f. 5.

1884. *Brancoceras sulcatum*, A. Hyatt, Proc. Boston Soc. Nat. Hist. vol. xxii. p. 326.

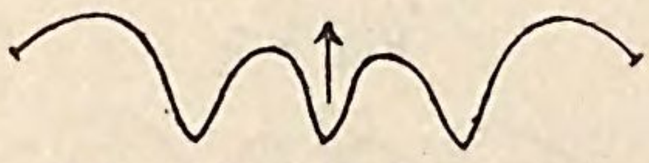
1884. *Goniatites* (*Brancoceras*) *sulcatus*, K. A. Zittel, Handb. d. Palæont. vol. ii. p. 419, f. 574.

1887. *Goniatites* (*Tornoceras*) *sulcatus*, F. Frech, Zeitschr. deutsch. geol. Gesell. vol. xxxix. p. 453.

1895. *Goniatites* (*Brancoceras*) *sulcatus*, K. A. v. Zittel, Grundzüge d. Palæont. p. 398, f. 1080.

Sp. Char. Shell inflated, involute; greatest thickness at about the middle of the lateral area, about three-fifths of the diameter of the shell; height of outer whorl about three-fifths of the diameter of the shell. Whorls eight to nine; inclusion complete; umbilicus closed, depressed. Whorl oval to subquadrate in section; indented to about three-fourths of its height by the preceding whorl; periphery broadly convex, somewhat flattened; sides convex, from about the middle of their area sloping towards the umbilicus. Body-chamber occupying one and a half whorls. Chambers thirteen or fourteen to a whorl; suture-line as in fig. 64. Test smooth; each whorl

Fig. 64.



Suture-line of *Brancoceras sulcatum*.
After Gümbel.

crossed by three simply-curved constrictions, which produce deep furrows on the cast.

Size. Shell attaining a diameter of about 35 mm.

Form. & Loc. Upper Devonian (Clymenien-Kalk): Schübelhammer, Bavaria.

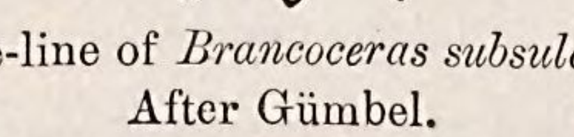
81838. Lateral aspect of specimen, 11·5 mm. in diameter, imbedded in matrix, exhibiting three constrictions, the test and a portion of the suture-line, labelled "*Goniatites sulcatus*" in Münster's handwriting; Schübelhammer. This specimen has a small umbilicus and the sides are not depressed around the umbilical margin, so that it approaches closely Münster's *Gon. subsulcatus*. *History unknown.*

Brancoceras subsulcatum (G. Münster).

1832. *Goniatites subsulcatus*, G. Münster, Ueber Planul. & Goniat. p. 23, pl. v. ff. 2 *a–d* (*not* T. Brown [1]).
1843. *Goniatites subsulcatus*, G. Münster, Beiträge zur Petrefactenkunde, i. 2nd ed. p. 17, pl. v.[a] ff. 2 *a–d*.
1850. *Aganides subsulcatus*, A. d'Orbigny, Prod. de Paléont. stratigr. vol. i. p. 60.
1852. *Ammonites retrorsus* (pars), C. G. Giebel, Fauna der Vorwelt, vol. iii. p. 457.
1862. *Goniatites subsulcatus*, G. Münster, = *Goniatites linearis*, G. Münster, C. W. Gümbel, Neues Jahrb. p. 297, pl. v. f. 11.
1884. *Brancoceras subsulcatum*, A. Hyatt, Proc. Boston Soc. Nat. Hist. vol. xxii. p. 326.
1890. *Brancoceras subsulcatum*, G. Steinmann & L. Döderlein, Elem. d. Paläont. pt. ii. p. 392.

Sp. Char. Shell inflated, involute; greatest thickness at the margin of the small umbilicus, about one-half of the diameter of the shell; height of outer whorl a little more than one-half of the diameter of the shell. Whorls five; inclusion almost complete; umbilicus very small, deep. Whorl in the young reniform in section and wider than high, becoming in the adult elliptical and higher than wide; indented to about two-thirds of its height by the preceding whorl; periphery broadly rounded; sides convex; inner area not defined. Body-chamber occupying about one and a half whorls. Chambers rather shallow, twelve to fourteen in a whorl; suture-line as in fig. 65. Test smooth, with only very fine lines of

Fig. 65.



Suture-line of *Brancoceras subsulcatum*.
After Gümbel.

growth, which are directed backward on the lateral area and form a deep broad sinus on the periphery; each whorl with three rather

[1] Trans. Manchester Geol. Soc. vol. i. p. 214, pl. vii. ff. 9, 10.

deep constrictions extending from the umbilicus to the periphery and becoming less distinct in the adult.

Size. The largest specimen in the Collection is somewhat elliptical, its longer diameter being about 47 mm.

Form. & Loc. Upper Devonian (Clymenien-Kalk): Schübelhammer, Bavaria; Saalfeld, Thuringia.

81845. Two examples, 37 and 21 mm. in diameter respectively, imbedded in matrix, labelled in Münster's handwriting "*Goniatites subsulcatus*," the smaller exhibiting plainly three sulci; Schübelhammer. *History unknown.*

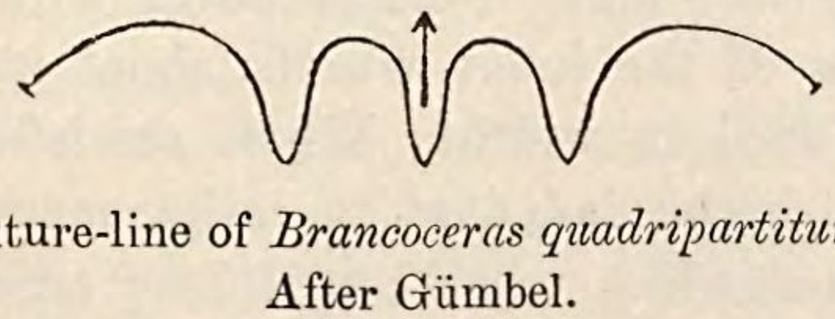
C. 4636. Elliptical natural cast bearing three sulci, probably referable to this species. *Transferred from Mus. Pract. Geol.*

Brancoceras quadripartitum (G. Münster).

1839. *Goniatites quadripartitus*, G. Münster, Beiträge zur Petrefactenkunde, i. p. 19.
1843. *Goniatites quadripartitus*, G. Münster, ibid. i. 2nd ed. p. 46.
1850. *Aganides quadripartitus*, A. d'Orbigny, Prod. de Paléont. stratigr. vol. i. p. 60.
1852. *Ammonites retrorsus* (pars), C. G. Giebel, Fauna der Vorwelt, vol. iii. p. 458.
1862. *Goniatites quadripartitus*, G. Münster, = *Goniatites linearis*, G. Münster, C. W. Gümbel, Neues Jahrb. p. 297, pl. v. f. 12.

Sp. Char. Shell compressed, involute; greatest thickness close to the umbilicus, about two-fifths of the diameter of the shell; height of outer whorl a little more than one-half of the diameter of the shell. Whorls (? number); inclusion complete; umbilicus closed, (in the cast) depressed. Whorl oval in section, higher than wide; much indented by the preceding whorl; periphery somewhat broadly rounded, slightly flattened; sides flattened, feebly convex; no distinct inner margin. Body-chamber (? length); chambers (? depth); suture-line as in fig. 66. Test nearly smooth, ornamented

Fig. 66.



Suture-line of *Brancoceras quadripartitum*.
After Gümbel.

only with very fine lines of growth, which form on the periphery a sinus having its concavity directed forwards. Outer whorl (in the cast) crossed by four or five sigmoidal constrictions extending

from the umbilicus to the periphery. 'Wrinkle-layer' composed of fine granulated striæ.

Size. The specimen in the Collection has a diameter of about 43 mm.

Form. & Loc. Upper Devonian (Clymenien-Kalk): Gattendorf, near Hof, Bavaria.

81833. Lateral aspect of an example, partly obscured by matrix, labelled "*Goniatites quadripartitus*" in Münster's handwriting; exhibiting plainly three constrictions and a portion of two others. *History unknown.*

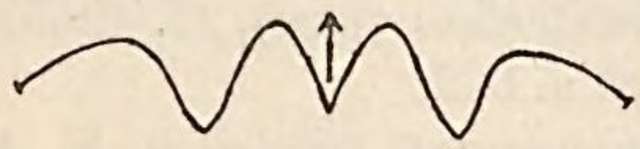
Brancoceras Belvalianum (L. G. de Koninck).

1843. *Goniatites Belvalianum*, L. G. de Koninck, in J. J. d'Omalius, Précis élém. de Géol. p. 515.
1842–44. *Ammonites Belvalianus*, L. G. de Koninck, Descr. Anim. Foss. terr. carb. Belgique, p. 566, pl. xlix. f. 5.
1850. *Aganides Belvalianus*, A. d'Orbigny, Prod. de Paléont. stratigr. vol. i. p. 115.
1852. *Ammonites Belvalianus*, C. G. Giebel, Fauna der Vorwelt, vol. iii. p. 461.
1880. *Goniatites Belvalianus*, L. G. de Koninck, Faune Calc. Carb. de la Belgique (Ann. Mus. Roy. d'Hist. nat. de Belgique, sér. Paléont. vol. v.), pt. ii. p. 95, pl. l. ff. 8, 9, 10.
1884. *Prionoceras Belvalianum*, A. Hyatt, Proc. Boston Soc. Nat. Hist. vol. xxii. p. 328.
1884. *Goniatites* (*Prionoceras*) *Belvalianus*, K. A. Zittel, Handb. d. Palæont. vol. ii. p. 419.
1889. *Brancoceras Belvalianum*, E. Holzapfel, Palæont. Abhandl., Dames & Kayser, vol. v. 1, p. 22.
1895. *Brancoceras Belvalianum*, K. A. v. Zittel, Grundzüge d. Palæont. p. 399.

Sp. Char. Shell rather small, globose in the young, discoidal in the adult; greatest thickness at the umbilical margin, about three-sevenths of the diameter of the shell; height of outer whorl about two-fifths of the diameter of the shell. Whorls five or six; inclusion almost complete; umbilicus infundibuliform, with angular margin, exposing the edges of the inner whorls, about one-quarter of the diameter of the shell in width. Whorl semielliptical in section, a little wider than high; indented to rather more than one-half of its height by the preceding whorl; periphery convex; sides feebly convex, flattened; inner margin well defined, narrow, steep. Body-chamber (? length). Chambers rather shallow; suture-line as in fig. 67. Test usually almost completely smooth, sometimes with well-marked lines of growth.

De Koninck describes the suture-line of this species as having a simple and pointed outer (external or peripheral) lobe, a subangular external saddle, a linguiform lateral lobe, and a rather broadly rounded

Fig. 67.



Suture-line of *Brancoceras Belvalianum*.
After De Koninck.

lateral saddle; on account of which characters Hyatt referred this species to his genus *Prionoceras*, stating that "the species [of *Prionoceras*] differ from *Brancoceras* only in the acuteness of the first pairs of saddles and lobes, and their peculiar pyramidal shape." But, as Holzapfel has observed, de Koninck described the external saddle of his *G. Belvalianus* as "subangular," not acute, and consequently this species belongs to *Brancoceras*, in which genus it has also been placed by von Zittel. If, however, the specimens in the National Collection are correctly identified (and they are labelled in de Koninck's handwriting "*Goniatites Belvalianus*"), we note that in one or two of the smaller specimens the external lobe is divided by a small median saddle as in the genus *Glyphioceras*; but as we have not been able to see the suture-line in the adult we accept de Koninck's description of it, and accordingly place this species in the genus *Brancoceras*.

Size. Shell attaining a diameter of 24 mm.

Form. & Loc. Calschiste de Tournai (Assise I *e*) = Carboniferous Limestone: Tournai, Belgium.

65039. Series of five specimens ranging in diameter from 8 to 20 mm.
Purchased, 1868.

Brancoceras rotatorium (L. G. de Koninck).

1842–44. *Ammonites rotatorius*, L. G. de Koninck, Descr. Anim. Foss. terr. carb. Belgique, p. 565, pl. li. f. 1.

1850. *Aganides rotatorius* (pars), A. d'Orbigny, Prod. de Paléont. stratigr. vol. i. p. 115.

1852. *Ammonites rotatorius* (pars), C. G. Giebel, Fauna der Vorwelt, vol. iii. p. 461.

1852–54. *Goniatites rotatorius* (pars), F. Roemer in H. G. Bronn, Lethæa Geogn. vol. i. pt. ii. p. 51 (not the figure).

1880. *Goniatites rotatorius* (pars), L. G. de Koninck, Faune Calc. carb. Belgique (Ann. Mus. Roy. d'Hist. nat. Belgique, sér. Paléont. vol. v.), pt. ii. p. 94, pl. xlvii. f. 12.

1884. *Brancoceras rotatorium* (? syn. of *Brancoceras Ixion*), A. Hyatt, Proc. Boston Soc. Nat. Hist. vol. xxii. p. 326.
1884. *Goniatites* (*Brancoceras*) *rotatorius*, K. A. Zittel, Handb. d. Palæont. vol. ii. p. 419, f. 575.
1889. *Goniatites rotatorius*=*Goniatites Ixion*, E. Holzapfel, Palæont. Abhandl., Dames & Kayser, vol. v. 1, p. 22.
1890. *Brancoceras rotatorium* (pars), G. Steinmann & L. Döderlein, Elem. d. Paläont. p. 392.
1895. *Goniatites* (*Brancoceras*) *rotatorius*, K. A. v. Zittel, Grundzüge d. Palæont. p. 398, f. 1097.

In his original description of this species, De Koninck says:—"Cette grande et belle espèce, dont nous ne connaissons que le moule intérieur, est discoide, fortement comprimée et largement évasé[e] vers l'ombilic. Ses tours de spire sont entièrement embrassants et faiblement renflés sur les côtés; leur dos est arrondi." But in the description which he gives in 1880, he makes no mention of the depressed area around the umbilicus, and the figure accompanying this description differs considerably from that given by him in 1844.

De Koninck considered the species to be next described (*Goniatites Ixion*, J. Hall) as identical with his *Gon. rotatorius*, in which opinion he is supported by de Verneuil, A. d'Orbigny, C. G. Giebel, F. Roemer, R. Hoernes, F. A. Quenstedt, E. Holzapfel, and Steinmann & Döderlein. A. Hyatt states that Hall's species "is a close ally, if not identical with" de Koninck's species. Nevertheless Prof. Hall [1] considers *Gon. Ixion* to be a distinct species, and mentions that de Koninck's figure of a specimen 110 mm. in diameter shows nineteen septa in the outer whorl, whereas in a specimen of *Goniatites Ixion* 85 mm. in diameter there are twenty-two, and an example of *G. Ixion* measuring 47 mm. in diameter has nineteen in its entire volution. He also states that "an examination of the original of de Koninck's species shows a greater rotundity of the periphery of the volutions, and a depressed area around the umbilicus, corresponding with the description."

Although the Collection contains well-preserved examples of the American species, the representative of the Belgian species in the Collection is so flattened, that the writers are unable to give an opinion from these specimens as to the identity or otherwise of the American and Belgian forms.

Dr. P. Fischer [2] states that the specimen which de Montfort

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[1] Nat. Hist. N. York, pt. vi. Palæont. vol. v. pt. 2, 1879, p. 476.
[2] Manuel de Conchyliologie, 1880–87, p. 380.

figured as the type of his genus *Aganides* belongs to de Koninck's species *Goniatites rotatorius*.

Form. & Loc. Calschiste de Tournai (Assise I *e*)=Carboniferous Limestone: Tournai, Belgium.

65032. A flattened specimen, 73 mm. in diameter.

Purchased, 1868.

Brancoceras Ixion (J. Hall).

[Fig. 62, p. 132.]

1847. *Goniatites rotatorius*, E. de Verneuil, Bull. Soc. géol. France, [2], vol. iv. p. 693.
1850. *Aganides rotatorius* (pars), A. d'Orbigny, Prod. de Paléont. stratigr. vol. i. p. 115.
1852. *Ammonites rotatorius* (pars), C. G. Giebel, Fauna der Vorwelt, vol. iii. p. 461.
1852–54. *Goniatites rotatorius* (pars), F. Roemer, in H. G. Bronn, Lethæa Geogn. vol. i. pt. 2, p. 516, pl. 1[1]. f. 16.
1860. *Goniatites rotatorius* ?, J. Hall, Thirteenth Rep. N. York State Cab. Nat. Hist. p. 101, ff. 15, 16.
1860. *Goniatites Ixion*, J. Hall, ibid. p. 125, woodc. ff. 1-3.
1876. *Goniatites rotatorius*, J. Hall, Illustr. Devon. Foss., Cephalopoda, pl. lxxiii. ff. 12–14.
1876. *Goniatites rotatorius*, F. Roemer, Lethæa geognostica, pt. i. Palæozoic, pl. xlvi. ff. 12 *a*, *b*.
1877. *Goniatites Ixion*, S. A. Miller, Catal. Amer. Pal. Foss. p. 169.
1879. *Goniatites Ixion*, J. Hall, Nat. Hist. N. York, pt. vi. Palæont. vol. v. pt. ii. p. 474, pl. lxxiii. ff. 12–14, pl. lxxiv. f. 12.
1880. *Goniatites rotatorius* (pars), L. G. de Koninck, Faune Calc. Carb. Belgique (Ann. Mus. Roy. d'Hist. nat. Belgique, sér. Paléont. vol. v.), pt. ii. p. 94.
1884. *Brancoceras Ixion* (? = *Brancoceras rotatorium*), A. Hyatt, Proc. Boston Soc. Nat. Hist. vol. xxii. p. 326.
1885. *Goniatites rotatorius*, R. Hoernes, Elem. d. Palaeont. p. 331, woodc. p. 458.
1885. *Goniatites rotatorius*, F. A. Quenstedt, Handb. Petrefakt. 3rd ed. p. 537, pl. xlii. f. 7.
1886. *Goniatites Ixion*, J. Hall, Geol. Surv. N. York, Fifth Ann. Rep. State Geologist, pl. (cxxviii.) 13, f. 3.
1888. *Goniatites Ixion*, J. Hall, Nat. Hist. N. York, pt. vi. Palæont. vol. v. pt. ii. Suppl. p. 40, pl. cxxviii. f. 3.
1889. *Goniatites Ixion*, S. A. Miller, N. Amer. Geol. & Palæont. p. 439 (2nd ed. of Catal.).
1889. *Goniatites rotatorius* = *Goniatites Ixion*, E. Holzapfel, Palæont. Abhandl., Dames & Kayser, vol. v. 1, p. 22.
1890. *Brancoceras rotatorium* (pars), G. Steinmann & L. Döderlein, Elem. d. Paläont. p. 392.

Sp. Char. Shell (cast) discoid; greatest thickness at a point distant from the umbilicus about one-fourth of the height of the whorl, one-third of the diameter of the shell in adult, one-half in younger specimens; height of outer whorl three-fifths of the diameter of the shell. Whorls seven or eight; inclusion complete; umbilicus closed, or very small in internal casts, and the inner volutions not at all exposed. Whorl elongate, semielliptical in section, its height about one and a half times the width; indented to nearly half its height by the preceding whorl; periphery somewhat abruptly rounded; sides gently curving and converging to the peripheral margin; inner margin not defined. Body-chamber and aperture unknown. Chambers numerous, measured at the highest point of the lateral saddle about one-eighth or one-ninth of the corresponding ventro-dorsal diameter in depth; suture-line as in fig. 62 *c* (p. 132). Test unknown.

Size. Shell attaining a diameter of more than 95 mm.

Form. & Loc. Goniatite Limestone, Kinderhook Group (Lower Carboniferous): Rockford, Indiana, United States.

C. 96. Two specimens, 96 and 71 mm. in diameter respectively. The smaller example with its suture-line is shown of about three-fourths of the natural size in figs. 62 *a*, *b*, *c* (p. 132). *Purchased*, 1880.

Brancoceras sp.

1890. *Goniatites* sp., A. H. Foord, Geol. Mag. [3] vol. vii. p. 102, pl. v. f. 4.

The specimen in the Collection is much too imperfect for specific identification, but the form of the suture-line shows that it is referable to Hyatt's genus *Brancoceras*. It seems to be allied to *B. rotatorium* (de Koninck) and *B. Ixion* (Hall). Its affinities are certainly with Carboniferous forms.

Form. & Loc. Carboniferous: Mt. Pierre, near the Fitzroy River, Kimberley District, Western Australia.

C. 4154. The figured specimen.
Presented by the Government of W. Australia, per H. P. Woodward, Esq., 1892.

Brancoceras sp.

C. 5767. A much crushed natural internal cast of the posterior portion of the body-chamber of a shell of from 60 to 70 mm. in diameter, probably referable to this genus. It

is labelled "Cast of part of *Goniatites sublobatus*. From Cape Ridge, 100 miles E. of King George's Sound, Australia." *Presented by Gerard Krefft, Esq.*, 1867.

Genus **PERICYCLUS**, E. v. Mojsisovics [1].

Syn. *Ellipsolithes*, J. Sowerby, 1813 [2]; *Ammonites*, J. Sowerby, 1821 [3] (pars), et auct.; *Ammonellipsites*, J. Parkinson, 1822 [4] (pars); *Nautilus*, J. Fleming, 1828 [5] (pars); *Goniatites*, L. G. de Kominck, 1843 [6] (pars), et auct.; *Nautilus* (*Temnocheilus*), F. M'Coy, 1844 [7] (pars); *Aganides*, A. d'Orbigny, 1850 [8] (pars); *Glyphioceras*, G. Steinmann & L. Döderlein, 1890 [9] (pars).

Type. *Ammonites princeps*, L. G. de Koninck, Descr. Anim. Foss. 1842–44, p. 579, pl. li. ff. 2, 3; *Goniatites princeps*, L. G. de Koninck, Faune Calc. Carb. de la Belgique (Ann. Mus. Roy. d'Hist. Nat. de Belgique, sér. Paléont. vol. v.), pt. ii. p. 116, pl. xlix. ff. 1, 2.

Gen. Char. Shell involute, with a narrow umbilicus and broad convex periphery, ornamented with strong direct transverse ribs, which are uninterrupted, although sometimes slightly curved backwards, on the periphery. Suture-line—external (outer or peripheral) lobe divided by a small median saddle; external (outer or peripheral) saddle spatulate; lateral lobe pointed, deep; lateral saddle broadly rounded; usually with a small auxiliary lobe at the umbilicus.

Carboniferous.

Remarks. Mojsisovics founded this genus upon the two Carboniferous species *Goniatites princeps*, de Koninck, and *Goniatites virgatus*, de Koninck, and regarded it as the Palæozoic ancestor of the Triassic genera *Acrochordiceras*, *Halorites*, and *Juvavites*. He did not, however, characterize it; but Hyatt, in adopting the genus, characterized it principally by its suture-line, which he described as having a spatulate external saddle and an additional broad angular lateral lobe. De Koninck, however, seems not to

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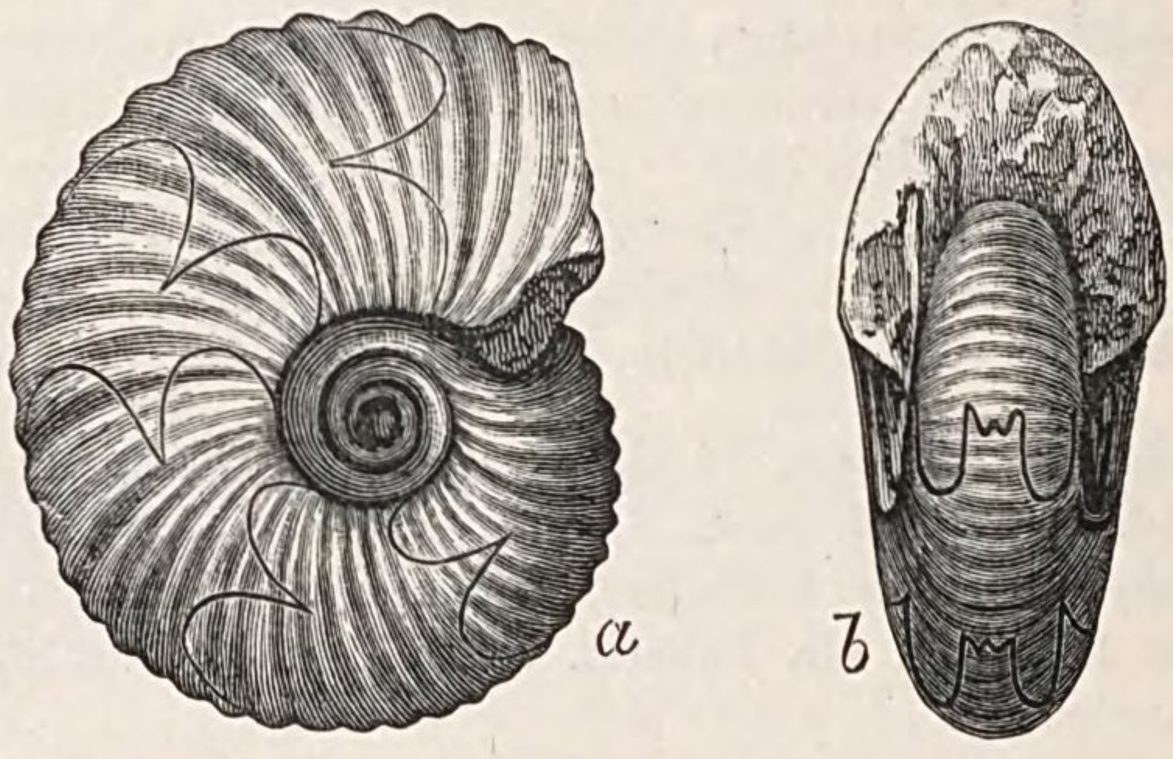
[1] Abhandl. d. k.-k. geol. Reichsanst., Wien, vol. x. 1882, p. 141.
[2] Min. Con. vol. i. p. 81.
[3] Ibid. vol. iii. p. 167, footnote.
[4] Introd. Foss. Org. Rem. pp. 164 & 233.
[5] Brit. Anim. p. 32.
[6] In J. J. d'Omalius, Précis élém. Géol. p. 515.
[7] Synop. Carb. Foss. Ireland, p. 21.
[8] Prod. de Paléont. stratigr. vol. i. p. 116.
[9] Elem. d. Paläont. pt. ii. p. 393.

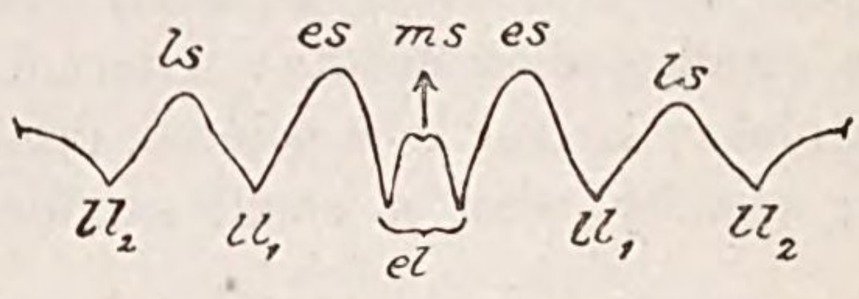
have recognized this latter, for he does not figure it. Holzapfel considers that in this genus, as also in *Glyphioceras*, too much importance must not be attached to the suture-line alone, for in some species of *Glyphioceras* an auxiliary lobe is present, and in

Fig. 68.



Pericyclus princeps.—*a*, lateral view; *b*, front view. After de Koninck.

Fig. 69.



Suture-line of *Pericyclus virgatus.*—*ms*, median saddle; *el*, external (outer or peripheral) lobe; *es*, external (outer or peripheral) saddle; ll_1, lateral lobe; *ls*, lateral saddle; ll_2, second lateral lobe. Reduced. After Holzapfel.

some cases it is as deep as in some forms of *Pericyclus*; and he points out further, that in some species of *Pericyclus* the external saddle is broadly rounded (*G. princeps*, de Koninck), in others more lancet-shaped and almost pointed (*G. virgatus*, de Kon.); and that the suture-line, general form of the shell, and the shape of the transverse section of the whorl are indeed as in *Glyphioceras*. This author considers the most important character of the genus to be the strong transverse ribbing, which crosses the periphery without interruption, the ribs here being merely bent backward; and he also points out that the border of the aperture (as shown by the transverse constrictions) does not possess either a lateral or a peripheral sinus, at all events of any large size, and that this character separates it from the normal type of Goniatite.

Steinmann and Döderlein unite this genus with Hyatt's *Glyphioceras*.

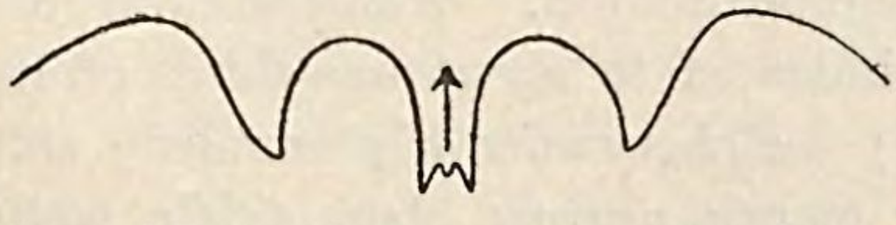
Pericyclus princeps (L. G. de Koninck).

[Fig. 68, p. 144.]

1843. *Goniatites princeps*, L. G. de Koninck, in J. J. d'Omalius, Précis élém. géol. p. 515.
1842–44. *Ammonites princeps*, L. G. de Koninck, Descr. Anim. Foss. p. 579, pl. li. ff. 2, 3.
1848. *Goniatites princeps* (pars), H. G. Bornn, Gesch. d. Natur, vol. iii. p. 543.
1850. *Aganides princeps*, A. d'Orbigny, Prod. de Paléont. stratigr. vol. i. p. 116.
1852. *Ammonites princeps*, C. G. Giebel, Fauna der Vorwelt, vol. iii. p. 644.
1878. *Goniatites princeps*, J. J. Bigsby, Thesaur. dev.-carb. pp. 336 & 339.
1880. *Goniatites princeps*, L. G. de Koninck, Faune Calc. Carb. de la Belgique (Ann. Mus. Roy. d'Hist. nat. de Belgique, sér. Paléont. vol. v.), pt. ii. p. 116, pl. xlix. ff. 1, 2.
1882. *Pericyclus princeps*, E. v. Mojsisovics, Abhandl. d. k.-k. geol. Reichsanst., Wien, vol. x. p. 141.
1884. *Pericyclus princeps*, A. Hyatt, Proc. Boston Soc. Nat. Hist. vol. xxii. p. 330.
1888. *Goniatites princeps*, R. Etheridge, Brit. Foss. vol. i., Palæozoic, p. 312.
1890. *Glyphioceras princeps*, G. Steinmann and L. Döderlein, Elem. d. Paläont. pt. ii. p. 393.

Sp. Char. Shell discoidal, compressed, umbilicated; greatest thickness at the umbilical margin; height of outer whorl nearly one-half of the diameter of the shell. Whorls seven or eight; inclusion one-half; umbilicus rather wide, infundibuliform, with an angular margin. Whorl semielliptical in section, about as wide as high; considerably indented by the previous whorl; periphery convex, sides feebly convex, flattened; inner margin narrow, steep, well-defined from the lateral area. Body-chamber (? length). Chambers (? depth); suture-line as in fig. 70. Test ornamented with transverse folds; these are simple in the adult, but some-

Fig. 70.



Suture-line of *Pericyclus princeps*. After de Koninck.

times bifurcated on the lateral area in the young, separated by interspaces rather wider than the folds, slightly backwardly-curved on the sides and with a wide sinus on the periphery.

Adult examples of this species are usually very much crushed, so that it is not possible to give the exact proportions in the above diagnosis. De Koninck gives the following dimensions of a young specimen having a diameter of 34 mm. :—thickness 18 mm. ; height of outer whorl 18 mm. ; width of umbilicus 10 mm. The dimensions of a young specimen in the British Museum collection are :— diameter 30 mm. ; height of outer whorl 11·5 mm. ; ditto above preceding whorl 8 mm. ; thickness 13 mm. ; width of umbilicus 9 mm.

Size. De Koninck records an adult specimen (somewhat deformed) with a diameter of 104 mm.

Form. & Loc. Calschiste de Tournai (Assise I e) : Tournai, Belgium.

C. 5771. Two fairly well-preserved specimens, 23·5 and 30 mm. in diameter respectively. *De Koninck Coll.*

C. 5772. Crushed example, 73 mm. in diameter, with an umbilicus 19 mm. wide, and finer ornaments than De Koninck indicates. *History unknown.*

Pericyclus virgatus ? (L. G. de Koninck).

1880. *Goniatites virgatus*, L. G. de Koninck, Faune Calc. Carb. de la Belgique (Ann. Mus. Roy. d'Hist. nat. de Belgique, sér. Paléont. vol. v.), pt. ii. p. 118, pl. xlix. ff. 4, 4 *a*.

1880. *Goniatites impressus*, L. G. de Koninck, ibid. p. 118, pl. xlix. ff. 3, 3 *a*.

1882. *Pericyclus virgatus*, E. v. Mojsisovics, Abhandl. d. k.-k. geol. Reichsanst., Wien, vol. x. p. 141.

1889. *Pericyclus virgatus*, E. Holzapfel, Palæont. Abhandl., Dames & Kayser, vol. v. 1, p. 34, pl. iii. ff. 8–10.

Sp. Char. Shell of medium size, discoidal, compressed ; greatest thickness at the umbilical margin, rather more than one-half of the diameter of the shell ; height of outer whorl about one-half of the diameter of the shell. Whorls few ; inclusion almost complete ; umbilicus narrow, about one-ninth of the diameter wide, infundibuliform, with subangular margin. Whorl suboval in section, about as wide as high ; indented to about one-third of its height by the preceding whorl ; periphery narrowly rounded ; sides feebly convex, flattened ; inner margin narrow, steep, fairly well-defined. Body-chamber (? length) ; chambers (? depth). (For suture-line of *P. virgatus*, see fig. 69, p. 144). Test ornamented with moderately fine transverse ribs separated by interspaces of about the same width ; they are slightly sinuous on the lateral area, slightly

recurved near the periphery, and on the latter, where they are a little thicker, form a broad shallow sinus. Up to a diameter of about 16 mm., the ribs are dichotomous, the point of division being at about the middle of the lateral area.

The above description is based upon the specimens in the National Collection, which are doubtfully referred to de Koninck's species. De Koninck says the ribs are not dichotomous, but they certainly are in these specimens up to a diameter of 16 mm.

Size. The largest specimen in the Collection is 19 mm. in diameter; but there is a fragment which belonged to a much larger example.

Form. & Loc. Carboniferous: Halifax, Yorkshire.

C. 5278. Four fairly well-preserved examples, ranging in diameter from 10·5 to 19 mm.; also a fragment of a much larger specimen. *Purchased*, 1895.

Pericyclus funatus (J. Sowerby).

1813. *Ellipsolithes funatus*, J. Sowerby, Min. Con. vol. i. p. 81, pl. xxxii.
1822. *Ammonellipsites funatus*, J. Parkinson, Introd. Foss. Org. Rem. pp. 164 & 233.
1828. *Nautilus funatus*, J. Fleming, Brit. Anim. p. 32.
1840. *Nautilus funatus*, L. Agassiz, in Desor's transl. of Sowerby's Min. Con. vol. i. p. 56, pl. xxiii. (xxxii.).
1843. *Goniatites funatus*, L. G. de Koninck, in J. J. d'Omalius, Précis élém. géol. p. 515.
1843. *Nautilus funatus*, J. Morris, Cat. Brit. Foss. p. 182.
1842–44. *Ammonites princeps* (pars), L. G. de Koninck, Descr. Anim. Foss. p. 579 (excl. figs.).
1848. *Goniatites princeps* (pars), H. G. Bronn, Gesch. d. Natur, vol. iii. p. 543.
1854. *Goniatites funatus*, J. Morris, Cat. Brit. Foss. 2nd ed. p. 303.
1888. *Goniatites funatus*, R. Etheridge, Brit. Foss. vol. i., Palæozoic, p. 311.

Sp. Char. Shell rather large, subdiscoidal, widely umbilicated; greatest thickness at the umbilical margin; height of outer whorl probably about one-third of the diameter of the shell. Whorls four or five; inclusion about one-half; umbilicus not very deep, nearly one-half of the diameter of the shell in width, with subangular margin. Whorl reniform in section, much wider than high; considerably indented by the preceding whorl; periphery broadly convex and continuous with the sides; inner margin narrow, well-defined, steep. Body-chamber, chambers, and suture-line not seen. Test ornamented with simple transverse rounded ribs, which are almost

direct on the sides and form a broad shallow sinus on the periphery; they are separated by rather wider interspaces; at intervals the whorl bears a constriction bounded anteriorly by a somewhat stronger rib which is raised into a node at the umbilical margin.

In the above diagnosis, which is based on Sowerby's type, exact proportions cannot be given owing to the distorted condition of the specimen. The suture-line is not shown.

This species is more widely umbilicated and more compressed than *P. plicatilis* (de Kon.); and more widely umbilicated than *P. princeps* (de Kon.), with which species it is united by Morris.

Size. Sowerby's type is elliptical; its diameters are 79 and 65 mm., and the diameters of its umbilicus 37 and 30 mm.

Form. & Loc. Carboniferous Limestone: Blackrock range, S.E. of Cork.

43884. Sowerby's type-specimen (marked *a*); also several imperfect specimens, with proportionally finer ornaments and smaller umbilicus, possibly indicating a species intermediate between the present species and *P. plicatilis* (de Kon.).
Sowerby Coll.

Pericyclus fasciculatus (F. M'Coy).

1844. *Goniatites fasciculatus*, F. M'Coy, Synop. Carb. Foss. Ireland, p. 13, pl. ii. f. 8.
1850. *Aganides fasciculatus*, A. d'Orbigny, Prod. de Paléont. stratigr. vol. i. p. 116.
1852. *Ammonites Listeri* (pars), C. G. Giebel, Fauna der Vorwelt, vol. iii. p. 476.
1854. *Goniatites fasciculatus*, J. Morris, Cat. Brit. Foss. 2nd ed. p. 303.
1855–57. *Goniatites fasciculatus*, J. Kelly, Journ. Geol. Soc. Dublin, vol. vii. p. 7.
1888. *Goniatites fasciculatus*, R. Etheridge, Brit. Foss. vol. i., Palæozoic, p. 311.
1888. *Gastrioceras fasciculatum*, M. Tzwetaev, Mém. Com. géol. St. Pétersbourg, vol. v. no. 3, p. 1.

Sp. Char. Shell discoidal, inflated, umbilicated; greatest thickness at the umbilical margin, about two-thirds of the diameter of the shell; height of outer whorl about three-sevenths of the diameter of the shell. Whorls few; inclusion rather more than one-half; umbilicus infundibuliform, with subangular margin, deep, about three-elevenths of the diameter in width, partly exposing the inner whorls. Whorl reniform in section, much wider than high; indented to about one-fourth of its height by the preceding

whorl; periphery broadly convex and continuous with the sides; inner area narrow, well-defined, steep, convex. Body-chamber (? length); aperture without either lateral or peripheral sinus. Chambers and suture-line not seen. Test with numerous unequal bundles of fine transverse ridges, having a deep backwardly directed sinus on the periphery; the bundles of transverse ridges about their own thickness apart, the intervening spaces being concave and smooth. Internal casts with subangular transverse ridges, some of which divide before crossing the periphery.

This species is smaller and less widely umbilicated than *P. furcatus*. Holzapfel [1] separates de Koninck's species (*Gon. fasciculatus*) from M'Coy's and places it in his own species *Pericyclus Kochi*. De Koninck's figure certainly represents a more compressed form than the smaller of the two specimens here referred to M'Coy's species.

Size. Shell attaining a diameter of about 38 mm.

Form. & Loc. Carboniferous Limestone: locality not recorded.

C. 5773. Two examples, 34 and 17·5 mm. in diameter respectively; the smaller bearing portions of the shell: locality not recorded. *History unknown.*

Pericyclus furcatus (F. M'Coy).

1844. *Nautilus* (*Temnocheilus*) *furcatus*, F. M'Coy, Synop. Carb. Foss. Ireland, p. 21, pl. iv. f. 13.

1850. *Aganides subfurcatus*, A. d'Orbigny, Prod. de Paléont. stratigr. vol. i. p. 115.

1854. *Goniatites furcatus*, J. Morris, Cat. Brit. Foss. 2nd ed. p. 303.

1855–57. *Temnocheilus furcatus*, J. Kelly, Journ. Geol. Soc. Dublin, vol. vii. p. 8.

1888. *Goniatites furcatus*, R. Etheridge, Brit. Foss. vol. i., Palæozoic, p. 311.

[*Not* 1841. *Goniatites furcatus*, G. Münster, Beitr. zur Petrefactenkunde, iv. p. 128, pl. xiv. f. 11.]

M'Coy described this species as follows:—"Discoid, compressed; sides gently curved; back rather narrow, rounded; umbilicus small, slightly exposing the whorls; surface marked with large, strong, rounded ribs, each of which, a short distance from the umbilicus, regularly branches into two of equal thickness, which making a rather acute, forward bend, in passing over the back, unite again on the opposite side, before reaching the umbilicus; intervening spaces wider than the ribs, concave, smooth."

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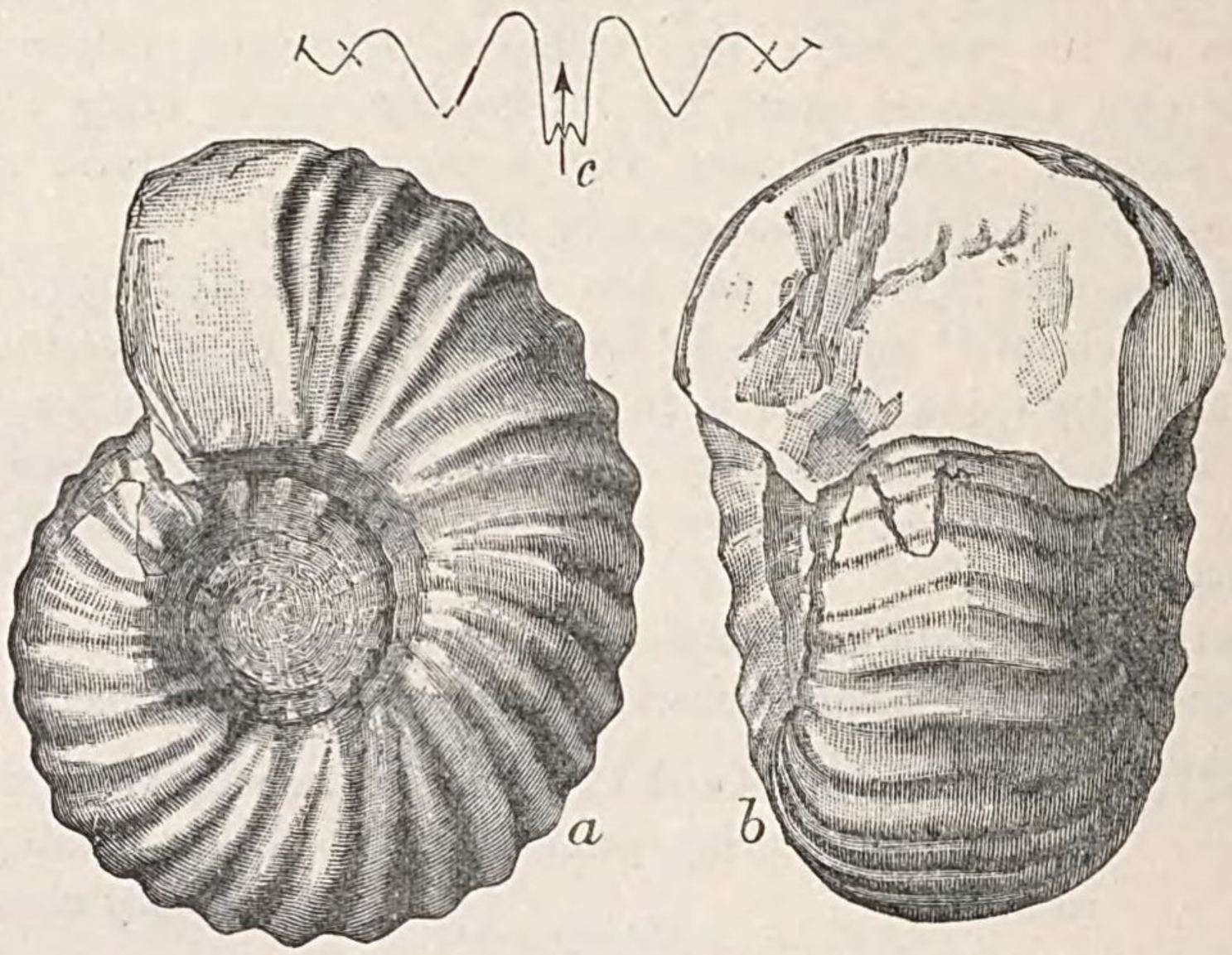
[1] Palæont. Abhandl., Dames and Kayser, vol. v. 1, 1889, p. 35, pl. iii. ff. 2–7.

The examples which we have seen bearing this ornamentation are much less compressed than M'Coy's type; we have, however, referred them to M'Coy's species, for it is not at all unlikely that

Fig. 71.



Pericyclus furcatus.—*a*, lateral view; *b*, front view; *c*, the last suture-line, its position being indicated in *a* and *b*. Drawn of the natural size from a specimen in the British Museum Collection.

the type, which belonged to Dr. Haines of Cork, was much compressed and distorted like so many of the fossils from the Carboniferous Limestone of Cork. We would therefore emend M'Coy's description as follows:—

Sp. Char. Shell discoidal, somewhat inflated, umbilicated; greatest thickness at the umbilical margin, a little more than two-thirds of the diameter of the shell; height of outer whorl about one-third of the diameter of the shell. Whorls few (exact number not seen); inclusion about one-half; umbilicus about one-third of the diameter in width, with subangular margin, deep, partly exposing the inner whorls. Whorl reniform in section, about twice as wide as high; not much indented by the preceding whorl; periphery broadly convex, continuous with the convex sides; inner margin rather wide, well-defined, very steep. Body-chamber occupying nearly the whole of the outer whorl; aperture not seen. Chambers (? depth); suture-line as in fig. 71 *c*. Test ornamented with strong rounded ribs which arise in pairs at, or almost close to, the umbilical margin, and crossing the periphery in a broad shallow forwardly-concave sinus, unite again on the opposite side at, or

almost close to, the umbilical margin; the intervening spaces wider than the ribs, concave, smooth.

The present species differs from *P. funatus* in its smaller umbilicus and coarser ornamentation, and from *P. fasciculatus* in its larger umbilicus and its coarse furcate ribbing.

Size. Shell attaining a diameter of 65 mm. (*fide* M'Coy).

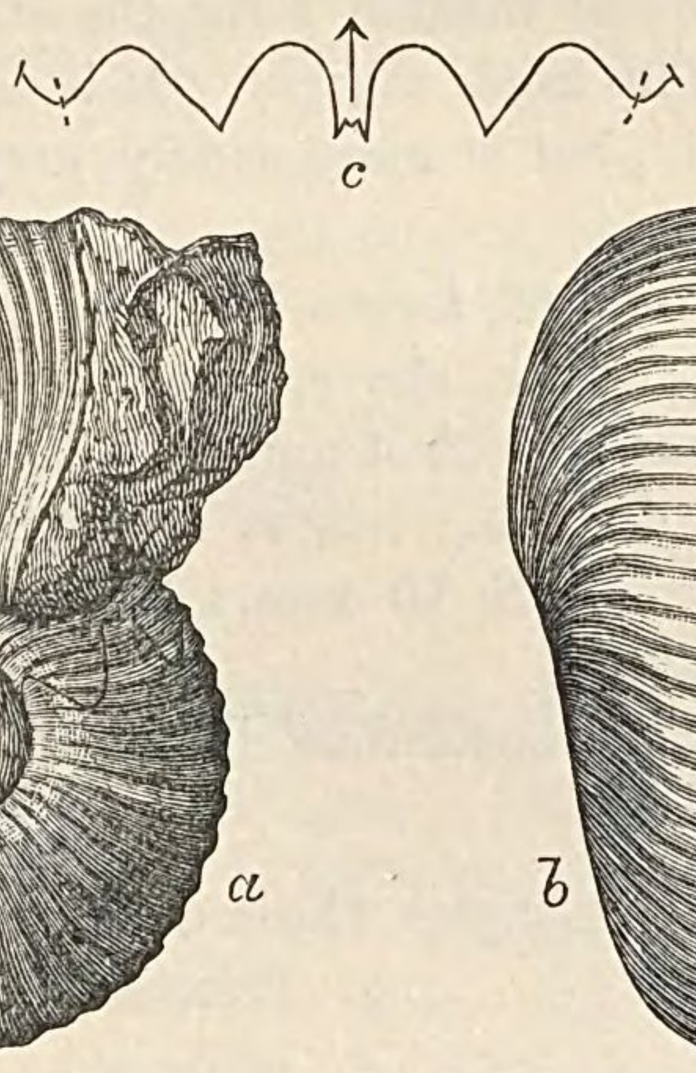
Form. & Loc. Carboniferous Limestone: Clane, co. Kildare Ireland.

C. 5933. The example figured above (fig. 71 *a*, *b*, *c*); its dimensions are:—diameter 51 mm.; height of outer whorl 20 mm.; ditto above preceding whorl 17 mm.; greatest thickness 35 mm.; width of umbilicus 17 mm.

Presented by Dr. A. H. Foord, 1897.

Pericyclus Doohylensis, sp. nov.

Fig. 72.



Pericyclus Doohylensis.—*a*, lateral view, showin g border of aperture and the last septum; *b*, peripheral view; *c*, suture-line. Drawn of the natural size from an example of the compressed form of the species in the British Museum Collection.

Sp. Char. Shell discoidal, somewhat inflated, umbilicated; greatest thickness near the umbilical margin, from about five-eighths (in the inflated form) to about five-ninths (in the compressed form) of the diameter of the shell; height of outer whorl from about two-fifths (in the inflated form) to about four-ninths (in the compressed form) of the diameter of the shell. Whorls (? number)

inclusion about three-fourths; umbilicus deep, exposing the edges of the inner whorls, about one-fourth of the diameter of the shell in width. Whorl semilunate (in the inflated form) or semielliptical (in the compressed form) in section, wider than high; indented to about one-quarter of its height by the preceding whorl; periphery broadly convex; sides convex, a little more flattened in the compressed than in the inflated form; inner margin well-defined, convex, nearly at right angles to the plane of symmetry. Body-chamber occupying the last whorl; aperture with a broad and very shallow peripheral sinus. Suture-line as in fig. 72 *c*. Test ornamented with numerous rounded transverse ribs, which are nearly direct on the lateral area and form on the periphery a broad, very shallow forwardly-concave sinus; these are separated by rather wider interspaces. The outer whorl with about four constrictions, the rib immediately posterior to each being somewhat stronger than the rest.

This species is much less widely umbilicated than *Pericyclus funatus* (J. Sow.), and is distinguished from *Pericyclus plicatilis* (de Kon.) by its less inflated form, the direction of its ornaments, and the form of its inner margin. It is nearly allied to *Pericyclus Kochi*, Holzapfel [1], but is more widely umbilicated and more compressed.

Size. (i) The inflated form—diameter 40 mm.; height of outer whorl 16 mm.; ditto above preceding whorl about 12 mm.; thickness 24·5 mm.; width of umbilicus 10 mm. (ii) The compressed form—diameter 45 mm.; height of outer whorl 20 mm.; ditto above preceding whorl 15 mm.; thickness 25 mm.; width of umbilicus 11·5 mm.

Form. & Loc. Carboniferous Limestone: Doohyle, near Rathkeale, co. Limerick.

C. 5934. The two examples whose dimensions are given above.

Presented by Dr. A. H. Foord, 1897.

Pericyclus, sp.

Sp. Char. Shell subglobose, umbilicated; greatest thickness at the umbilical margin, about five-eighths of the diameter of the shell; height of outer whorl about two-fifths of the diameter of the shell. Whorls (? number); inclusion about one-half; umbilicus about one-third of the diameter of the shell in width, deep, with subangular margin, partly exposing the inner whorls. Whorl semilunate in section, wider than high; indented to about one-fifth of its height by the preceding whorl; periphery broadly

[1] Palæont. Abhandl., Dames & Kayser, vol. v. 1, 1889, p. 35, pl. iii. ff. 2–7.

convex, continuous with the convex sides; inner margin narrow, steep, well-defined. Body-chamber, chambers, and sutures not seen. Test ornamented with simple fine transverse rounded ribs, which are directed slightly backward and cross the periphery in a broad shallow sinus; they are separated by interspaces of about their own width; a few bifurcate on the lateral area. The outer whorl bears five constrictions having the same direction as the ribs, the ribs bounding each being somewhat thickened.

The above description is based upon a single specimen in the Gilbertson Collection in the British Museum. The locality is not recorded, but the specimen is probably British. The species appears to come very near *P. Kochi*, Holzapfel [1], but it has a wider umbilicus and the ribs are more backwardly-directed.

Form. & Loc. Carboniferous Limestone: locality unrecorded.

C. 254. Specimen described above. Its dimensions are:—diameter 42 mm.; height of outer whorl 16·5 mm.; ditto above preceding whorl 13 mm.; thickness 27 mm.; width of umbilicus 14 mm. The outer whorl bears about 70 ribs. *Gilbertson Coll.*

The following specimen is probably referable to the genus *Pericyclus*:—

C. 242. Lateral aspect of an internal cast, about 40 mm. in diameter, in matrix: Carboniferous Limestone; locality not recorded. *Gilbertson Coll.*

Genus **GLYPHIOCERAS**, A. Hyatt [2].

Syn. *Nautilites*, W. Martin, 1809 [3] (pars); *Ellipsolites*, J. Sowerby, 1813 [4] (pars); *Ammonites*, J. Sowerby, 1814 [5] (pars), et auct.; *Nautellipsites*, J. Parkinson, 1822 [6]; *Goniatites*, De Haan, 1825 [7] (pars), et auct.; *Globites*, De Haan, 1825 [8] (pars); *Orbulita*, J. Fleming, 1828 [9]; *Aganides*, A. d'Orbigny, 1850 [10] (pars);

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[1] Palæont. Abhandl., Dames & Kayser, vol. v. 1, 1889, p. 35, pl. iii. ff. 2–7 [especially f. 7].

[2] Proc. Boston Soc. Nat. Hist. vol. xxii. 1884, p. 328.

[3] Petrif. Derb. pl. vii. ff. 3–5 and p. 15.

[4] Min. Con. vol. i. p. 83.

[5] Ibid. vol. i. pp. 115, 116.

[6] Introd. Foss. Org. Rem. pp. 164 & 233.

[7] Mon. Ammon. et Goniat. p. 129.

[8] Ibid. pp. 143, 148.

[9] Hist. Brit. Anim. p. 248.

[10] Prod. de Paléont. Stratigr. vol. i. p. 115.

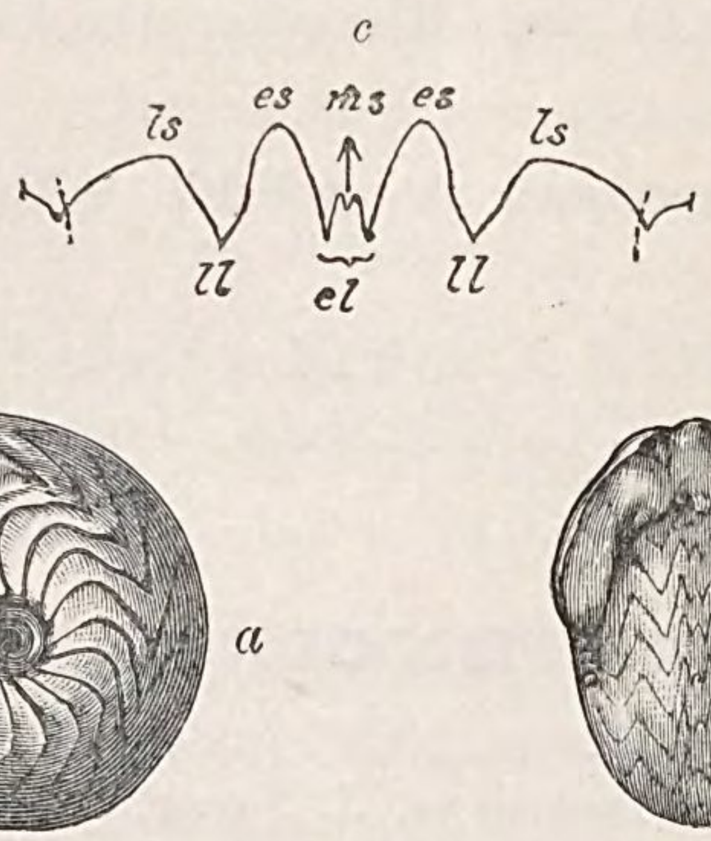
Munsteroceras, A. Hyatt, 1884[1] (pars); *Homoceras*, A. Hyatt, 1884[2]; *Nomismoceras*, A. Hyatt, 1884[3] (pars); *Glyphioceras*, G. Steinmann & L. Döderlein, 1890[4] (pars).

Types.—Section 1. *Goniatites crenistria*, J. Phillips, Pal. Foss. Cornwall, Devon, &c., 1841, p. 121, pl. l. ff. 234 *a-g*.
Section 2. *Goniatites obtusus*, J. Phillips, Geol. Yorkshire, pt. ii. 1836, p. 234, pl. xix. ff. 10, 11, (? 13)[5].

Gen. Char. Shell involute, with a narrow or closed umbilicus, smooth or finely striated, with a convex periphery. Suture-line—external (outer or peripheral) lobe divided by a small median saddle; external (outer or peripheral) saddle narrow, rounded or pointed; lateral lobe pointed, deep; lateral saddle broadly rounded; usually also with a small auxiliary lobe at the margin of the umbilicus.

Carboniferous.

Fig. 73.



Glyphioceras sphæricum.—*a*, lateral view: *b*, front view: *c*, suture-line—*ms*, median saddle; *el*, external (outer or peripheral) lobe; *es*, external (outer or peripheral) saddle; *ll*, lateral lobe; *ls*, lateral saddle; the dotted line indicates the position of the umbilical margin, and the short terminal line that of the suture of the shell. *a* and *b* are drawn from a specimen (no. 30214) in the British Museum Collection from the Carboniferous Limestone, near Buxton, Derbyshire; *c* is traced from Sowerby's figured specimen, also in the British Museum. Natural size.

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[1] Proc. Boston Soc. Nat. Hist. vol. xxii. p. 326.
[2] Ibid. vol. xxii. p. 330.
[3] Ibid. vol. xxii. p. 330.
[4] Elem. d. Paläont. pt. ii. p. 393.
[5] Prof. Hyatt mentions ff. 10–13, but we have referred f. 12 to another species—*Gly. Phillipsi.*

Remarks.—Hyatt divided this genus into two sections: the first contained involute, umbilicate, globose shells, *Goniatites crenistria*, J. Phillips (Pal. Foss. Cornwall, Devon, &c., 1841, p. 121, pl. l. f. 234), being the first mentioned species; the second included shells with more compressed whorls, with similar sutures, but often with slightly rounded or linguiform saddles, and with smaller median saddles, the first-mentioned example being *Goniatites obtusus*, J. Phillips (Geol. Yorkshire, pt. ii. 1836, p. 234, pl. xix. ff. 10–13).

As will be seen from the above synonymy, we have, like Holzapfel, included in this genus also *Munsteroceras* (pars), *Homoceras*, and *Nomismoceras* (pars) of Hyatt. Thus extended, the genus embraces the greater part of Beyrich's *Carbonarii*, or the *Genufracti* of the Bros. Sandberger; the forms not included being referable to *Gastrioceras*, Hyatt, *Pericyclus*, Mojsisovics, and *Nomismoceras* (pars), Hyatt.

Hyatt's *Munsteroceras* included shells similar in general form to *Glyphioceras*, but their suture-line having a deep parallel-sided external lobe, a shallow median saddle, and a rounded lateral lobe; *Glyphioceras*, according to Hyatt, having a broader external lobe with its sides inclined, a higher median saddle, and the "first lateral" saddle either pointed or subangular. These characters do not, however, appear to be of generic value, for of the species which Hyatt referred to *Glyphioceras*, *Gon. nitidus*, Phill., has a very shallow median saddle, while *Gon. stenolobus*, Phill., and *Gon. platylobus*, Phill., have distinctly rounded lateral saddles.

Hyatt founded the genus *Homoceras* on the single species *Gon. calyx*, Phill., which Holzapfel regards as probably the young either of *Gon. mutabilis*, Phill., or of a nearly related form. We have not been able to identify with certainty Phillips's figured specimen in the Gilbertson Collection, but one of the examples there (possibly the type) resembles very closely indeed some examples which are here referred to as a widely-umbilicated form of *Glyphioceras diadema* (p. 204). It is most probably a young form of *Glyphioceras*.

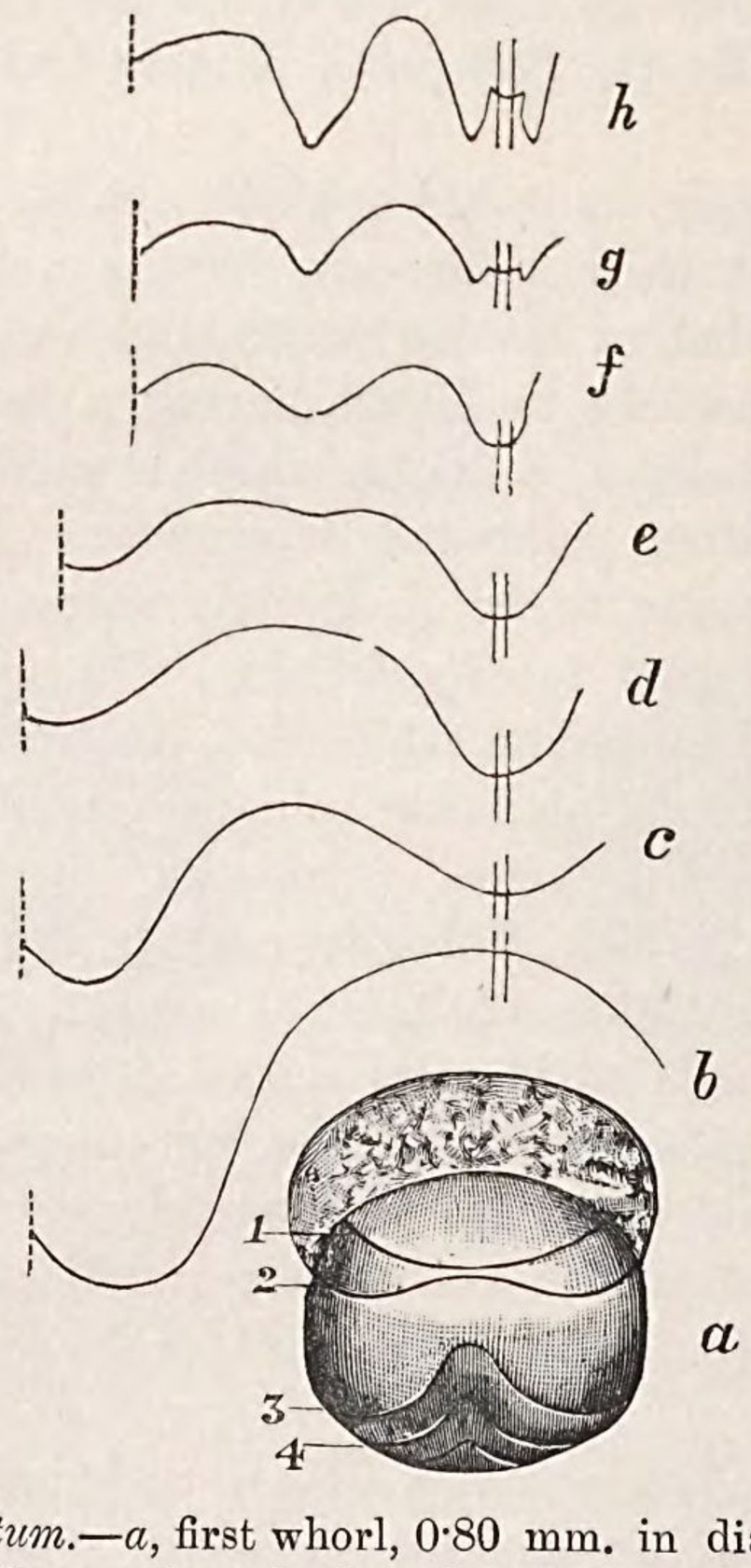
In his genus *Nomismoceras*, Hyatt included not only flat, discoidal, evolute, widely-umbilicated shells, such as *Gon. spirorbis*, Phill., and *Gon. rotiformis*, Phill., but also much more involute shells, such as *Gon. paucilobus*, Phill., and *Gon. platylobus*, Phill. The two latter species we have grouped with *Glyphioceras*, reserving the name *Nomismoceras* for the very evolute forms.

The genus *Glyphioceras* then comprises only Carboniferous and Permo-carboniferous species; those referred by Hyatt to

Munsteroceras, and spoken of as of Devonian age, are from the Goniatite Limestone of Indiana, now recognized as of Carboniferous age.

As to the ancestors of the genus, *Glyphioceras*, in its general form and in the character of its suture-line, recalls the genus *Gephyroceras*, which occurs in the lower part, but has not been found in the upper beds, of the Upper Devonian. Hyatt regarded *Brancoceras* as the ancestor of *Glyphioceras*, the only difference between the two being that in the former the external lobe is simple, while in the latter it is divided by a small median saddle. *Brancoceras*, which is probably derived from the Middle Devonian *Tornoceras*, appears in the Upper Devonian and disappears in the Lower Carboniferous.

Fig. 74.



Glyphioceras micronotum.—*a*, first whorl, 0·80 mm. in diameter, showing the first four suture-lines, enlarged; *b*, *c*, *d*, *e*, first, second, third, and seventh suture-lines, enlarged; *f*, *g*, *h*, suture-lines at a diameter of 1·25, 5·50, and 13 mm. respectively. After Branco.

As a descendant of the genus may be mentioned *Thalassoceras*, Gemmellaro, which agrees in the general form of the shell, and exhibits only a slight difference in the suture-line. Gemmellaro

referred this genus to the *Tropitidæ*, and derived it directly from *Dimorphoceras*; but this latter differs so considerably both in the form and in the ornaments of the shell, as well as in the character of the suture-line, that Holzapfel does not regard *Dimorphoceras* as a transitional form between *Glyphioceras* and *Thalassoceras*, neither does he consider the last-named genus to belong to the *Tropitidæ*.

Dr. Branco [1] has figured and described the protoconch, and also the development of the suture-line, in several species belonging to this genus (see fig. 74).

Glyphioceras sphæricum (W. Martin).

1809. *Conchyliolithus Nautilites sphæricus*, W. Martin, Petrif. Derb. p. 15, pl. vii. ff. 3, 4, 5.
1814. *Ammonites sphæricus*, J. Sowerby, Min. Con. vol. i. p. 116, pl. liii. f. 2.
1825. *Goniatites sphæricus*, G. de Haan, Monogr. Ammon. et Goniat. p. 159.
1828. *Orbulita sphærica*, J. Fleming, Hist. Brit. Anim. p. 248.
1829. *Globites sphæricus*, F. Holl, Handb. d. Petrefact. p. 227.
1832. *Ammonites carbonarius* (pars), L. v. Buch, Phys. Abhandl. d. k. Akad. d. Wissensch. Berlin for 1830, p. 176, pl. ii. ff. 9, 9′–9‴ (*not* f. 9ⁱᵛ).
1836. *Goniatites sphæricus*, J. Phillips, Geol. Yorks. pt. ii. p. 234, pl. xix. ff. 4, 5, 6.
1836. *Ammonites sphæricus*, W. Buckland, Geol. & Mineral. vol. ii. p. 61, pl. xl. f. 3.
1837. *Ammonites sphaericus*, H. E. Beyrich, De Goniatitis in montibus rhenanis occurrentibus, p. 13; and Beitr. Kenntn. Verstein. rhein. Uebergangsgeb. p. 38.
1842–44. *Ammonites sphæricus*, L. G. de Koninck, Descr. Anim. Foss. p. 570, pl. xlix. f. 6, pl. l. ff. 9, 10.
1843. *Goniatites sphæricus*, J. Morris, Cat. Brit. Foss. p. 180.
1844. *Goniatites sphæricus*, F. M'Coy, Synop. Carb. Foss. Ireland, p. 15.
1846. *Goniatites sphaericus* (pars), F. A. Quenstedt, Petrefact. Deutsch. vol. i. (Cephalopoden), p. 66, pl. iii. f. 11 (excl. ff. 10 *a–d*).
1848. *Goniatites sphæricus*, J. H. Cumming, Isle of Man, p. 357.
1848. *Goniatites sphæricus*, H. G. Bronn, Gesch. d. Natur, vol. iii. p. 544.
1850. *Aganides sphæricus* (pars), A. d'Orbigny, Prod. de Paléont stratigr. vol. i. p. 115.
1852. *Ammonites sphaericus* (pars), C. G. Giebel, Fauna der Vorwelt, vol. iii. p. 471.
1852. *Goniatites sphaericus*, F. A. Quenstedt, Handb. d. Petrefact. p. 351, pl. xxvi. f. 25.
1854. *Goniatites sphæricus*, J. Morris, Cat. Brit. Foss. 2nd ed. p. 304.

[1] Palæontographica, vol. xxvii. 1880.

1855. *Aganides sphæricus*, F. M'Coy, Brit. Pal. Foss. p. 566.
1855–57. *Goniatites sphæricus*, J. Kelly, Journ. Geol. Soc. Dublin, vol. vii. p. 7.
1860. *Goniatites sphaericus*, E. d'Eichwald, Lethæa rossica, vol. i. p. 1322.
1862. *Goniatites sphæricus*, T. Wardle, in J. Sleigh's History of Ancient Leek, p. 281, pl. i. f. 3.
1867. *Goniatites sphaericus*, H. Trautschold, Bull. Soc. Imp. Nat. Moscou, vol. xl. no. iii. p. 44, pl. v. f. 10.
1875. *Goniatites sphæricus*, W. H. Baily, Charact. Foss. p. 117, pl. xl. ff. 9 *a*, *b*.
1876. *Goniatites sphæricus*, J. Armstrong, J. Young, & D. Robertson, Cat. Western Scott. Foss. p. 58.
1878. *Goniatites sphæricus*, G. A. Lebour, Geol. Northumberland, p. 68.
1880. *Goniatites sphæricus* (pars), L. G. de Koninck, Faune Calc. Carb. de la Belgique (Ann. Mus. Roy. d'Hist. nat. de Belgique, sér. Paléont. vol. vi.), pt. ii. p. 97, pl. xlvii. ff. 3, 4, & 5.
1884. *Glyphioceras sphaericum*, A. Hyatt, Proc. Boston Soc. Nat. Hist. vol. xxii. p. 329.
1884. *Glyphioceras carbonarium* (pars), A. Hyatt, ibid. vol. xxii. p. 329.
1885. *Goniatites sphaericus*, F. A. Quenstedt, Handb. d. Petrefact. 3rd ed. p. 538, pl. xlii. f. 3.
1887. *Goniatites sphæricus*, D. L. Mallada, Mem. Com. del Mapa Geologico de España, vol. i. pt. ii. p. 664, pl. iii. ff. 1, 2.
1888. *Goniatites sphæricus*, R. Etheridge, Brit. Foss. vol. i. Palæozoic, p. 312.
1890. *Glyphioceras sphaericum*, G. Steinmann & L. Döderlein, Elem. d. Paläont. pt. ii. p. 393.
1895. *Goniatites sphæricus*, G. H. Morton, Proc. Liverpool Nat. Field Club for 1894, p. 23.
1895. *Glyphioceras sphæricum*, K. A. v. Zittel, Grundzüge d. Palæont. p. 399.

Sp. Char. Shell globular, greatest thickness almost close to the edge of the umbilicus, about three-fourths of the diameter of the shell in the adult, proportionately greater in the young; height of outer whorl about four-ninths of the diameter of the shell. Whorls eight to ten; inclusion almost complete; umbilicus rather small, acute-edged, a little more than one-sixth of the diameter in width, with steep sides. Whorl semilunate in section, its height about three-fifths of its width; indented to rather more than one-half of its height by the preceding whorl; periphery broadly convex; sides convex, very slightly depressed around the umbilicus in the adult; inner area nearly perpendicular to the plane of symmetry. Body-chamber occupying the last whorl, aperture not seen. Chambers not very deep, about eighteen in a whorl; suture-line as in fig. 75.

Test with fine spiral striæ, rarely preserved; internal casts with obscure transverse striæ, and at intervals with very shallow constrictions.

Fig. 75.

Suture-line of *Glyphioceras sphæricum*. Drawn, of the natural size, from Sowerby's figured specimen.

Size. Shell attaining a diameter of 60 mm. with a thickness of 46 mm.

Form. & Loc. Carboniferous Limestone:—*British*: Derbyshire; Bolland, Yorkshire; Westmoreland; Fremington, N. Devon; Limerick, Ireland. *Foreign*: Visé, Belgium. Culm:—*Foreign*: Iberg, near Grund, N.W. Hartz.

25294. Fairly well-preserved, entirely septate, natural cast 37·5 mm. in diameter; Ireland. *Purchased*, 1850.

30214 a, b. Two entirely septate examples, 26·5 and 34 mm. in diameter respectively, admirably showing the suture-lines: Crowdicote, near Buxton, Derbyshire. The larger specimen is drawn of the natural size in fig. 73 *a*, *b*, p. 154. *Purchased*, 1852.

43871. Specimen figured by Sowerby (*l. c.* pl. liii. f. 2) and piece of matrix in which it was imbedded, showing it to be the inner whorls of a specimen the septate portion of which has a diameter of more than 40 mm. The figured portion is 25·5 mm. in diameter and 23·5 mm. in thickness. This may have been Martin's type. Derbyshire. *Sowerby Coll.*

51388. Two specimens, 13 and 20 mm. in diameter respectively; Bolland, Yorkshire. *Purchased*, 1867.

64763. Twelve examples, ranging from 6 to 30 mm. in diameter, some showing the ornaments of the test, others the suture-line; Visé, Belgium. *De Koninck Coll.*

65176. Imperfect example, 32 mm. in diameter, belonging either to this species or to *Gly. crenistria*; near Limerick. *Purchased*, 1868.

75127. Imperfect specimen, 35 mm. in diameter, with fragments of the test; Westmoreland. *Toulmin-Smith Coll.*

97357 a. Two septate specimens, 7 and 9 mm. in diameter respectively; locality not recorded.
Presented on behalf of the late Mr. John Rofe, 1878.

C. 290. Four well-preserved examples, ranging in diameter from 36 to 60 mm., one of which (*a*) is figured by Phillips (*l. c.* pl. xix. f. 4); Bolland, Yorkshire.
Gilbertson Coll.

C. 1610. Pyritized specimen, 20·5 mm. in diameter, and the inner whorls of a larger but similar specimen in matrix; Fremington, North Devon. *Purchased*, 1886.

C. 1651. Two examples, 18 and 23 mm. in diameter respectively, with fragments of the test; Iberg, near Grund, N.W. Hartz. *Presented by John Edward Lee, Esq.*, 1885.

C 1652. Imperfect specimen in matrix, cut and polished; Iberg, near Grund. *Presented by John Edward Lee, Esq.*, 1885.

C. 5091. Three examples, ranging in diameter from 19·5 to 45 mm., with fragments of the test; Bolland. *History unknown.*

C. 5092, C. 5093. Three specimens, 24, 44, and 55 mm. in diameter respectively, the two larger with fragments of the test; locality not recorded. *History unknown.*

C. 5094. Two entirely septate, inflated examples, each about 25 mm. in diameter; locality not recorded. *History unknown.*

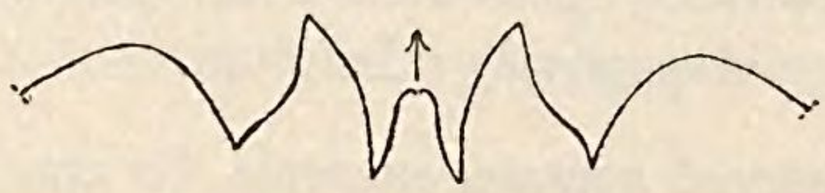
Glyphioceras crenistria (J. Phillips).

1836. *Goniatites crenistria*, J. Phillips, Geol. Yorks. pt. ii. p. 234, pl. xix. ff. 7, 8, 9.
? 1841. *Goniatites crenistria*, J. Phillips, Pal. Foss. Cornwall, Devon, and W. Somerset, p. 121, pl. l. ff. 234 *a–g*.
? 1843. *Goniatites crenistria*, F. A. Roemer, Verstein. Harzgeb. p. 33, pl. ix. ff. 10 *a*, *b*.
1843. *Goniatites crenistria*, J. Morris, Cat. Brit. Foss. p. 179.
1842–44. *Ammonites striatus* (pars), L. G. de Koninck, Descr. Anim. Foss. p. 568.
1848. *Goniatites crenistria*, J. H. Cumming, Isle of Man, p. 357.
1848. *Goniatites striatus* (pars), H. G. Bronn, Gesch. d. Natur, vol. iii. p. 545.
1850. *Aganides striatus* (pars), A. d'Orbigny, Prod. de Paléont. stratigr. vol. i. p. 115.
1850. *Goniatites crenistria*, F. A. Roemer, Palaeontogr. vol. iii. p. 51, pl. viii. ff. 13 *a*, *b*, *c*; and Beitr. zur geol. Kenntn. nordwestl. Harzgeb. p. 51, pl. viii. ff. 13 *a*, *b*, *c*.

1850–56. *Goniatites crenistria* (pars), G. & F. Sandberger, Verstein. rhein. Schichtensyst. Nassau, p. 74.
1852. *Ammonites sphaericus* (pars), C. G. Giebel, Fauna der Vorwelt, vol. iii. p. 471.
1852. *Goniatites crenistria*, F. A. Roemer, Beitr. zur geol. Kenntn. nordwestl. Harzgeb. pt. ii. p. 93, pl. xiii. ff. 29 *a*, *b*, *c*.
1854. *Goniatites crenistria*, J. Morris, Cat. Brit. Foss. 2nd ed. p. 303.
1855. *Aganides sphaericus*, var. *β. crenistria*, F. M'Coy, Brit. Pal. Foss. p. 567.
1855–57. *Goniatites crenistria*, J. Kelly, Journ. Geol. Soc. Dublin, vol. vii. p. 7.
1870. *Goniatites sphæricus*, F. Roemer, Geol. Oberschlesien, p. 55, pl. vi. ff. 2, 2 *a*, 2 *b*.
1880. *Goniatites striatus* (pars), L. G. de Koninck, Faune Calc. Carb. Belgique (Ann. Mus. Roy. d'Hist. nat. Belgique, sér. Paléont. vol. v.), pt. ii. p. 101.
1882. *Goniatites crenistria*, C. Barrois, Mém. Soc. géol. du Nord, vol. ii. no. 1, p. 292, pl. xiv. f. 1.
1884. *Glyphioceras crenistria*, A. Hyatt, Proc. Boston Soc. Nat. Hist. vol. xxii. p. 329.
1888. *Goniatites crenistria*, R. Etheridge, Brit. Foss. vol. i. Palæozoic, p. 311.
1895. *Glyphioceras crenistria*, K. A. v. Zittel, Grundzüge d. Palaeont. p. 399.

Sp. Char. Shell subglobose; greatest thickness in the adult at a short distance from the margin of the umbilicus, in immature specimens at the margin of the umbilicus, about three-fifths of the diameter of the shell; height of outer whorl a little more than one-half of the diameter of the shell. Whorls six or seven; inclusion almost complete; umbilicus small, open, about one-tenth of the diameter in width. Whorl semielliptical in section, rather wider than high; indented to from one-half (in the young) to one-third (in the adult) of its height by the preceding whorl; periphery

Fig. 76.



Suture-line of *Glyphioceras crenistria*. Drawn of the natural size from a specimen in the British Museum Collection (No. C. 5080).

broadly convex; sides not very convex, rather flattened, the portion around the umbilicus prominent in the adolescent stage, slightly depressed in the adult; inner area imperfectly defined, in the cast almost at right angles to the plane of symmetry. Body-chamber

occupying a complete whorl, aperture not seen. Chambers shallow, 19 or 20 in a whorl; suture-line as in fig. 76. Test thin, with fine crenulated, feebly reticulated, curved, transverse striæ which form a broad forwardly-concave sinus on the periphery, becoming almost smooth in the adult.

Size. Shell attaining a diameter of 66 millim.

Form. & Loc. Carboniferous Limestone :—*British* : Caldbeck, Cumberland; Crowdicote, near Buxton, Derbyshire; Swimbridge, N. Devon; Westmoreland; Todmorden, Bolland, Hill Bolton, Yorkshire; Ireland.—*Foreign*: Visé, Belgium; Grund, N.W. Hartz. Culm :—*British*: (?Waddon Barton, near Chudleigh, Devon; Bampton, Devon).—*Foreign*: (?Marburg, Nassau; Herborn, Nassau); Hagen, Westphalia.

(i) *Carboniferous Limestone.*

18777. Example, 54 mm. in diameter, showing the gradual disappearance of the ornaments in the adult shell; locality not recorded. *Presented by E. Charlesworth, Esq.*, 1845.

24764. Two specimens, 22 and 45·5 mm. in diameter respectively; and an imperfect example about 28 mm. in diameter; locality not recorded. *Purchased*, 1849.

30214 c. Well-preserved internal cast, 39 mm. in diameter, showing suture-line; Crowdicote, near Buxton, Derbyshire. *Purchased*, 1852.

30239. Rather widely umbilicated example, 59 mm. in diameter, in matrix, probably belonging to this species; locality not recorded. *Dixon Coll.*

47650. Three elliptical distorted specimens, 42·5, 13·5, and 11 mm. in diameter respectively, the largest showing sculpture of test; locality not recorded. *Paul Mohr Coll.*

47654. Two imperfectly preserved examples, 11 and 24 mm. in diameter respectively; Belgium. *Paul Mohr Coll.*

50183. Well-preserved septate example, 38 mm. in diameter, with fragments of the test; Ireland. *Morris Coll.*

64788. Four somewhat distorted specimens, ranging in diameter from 40 to about 60 mm.; Visé, Belgium. *Purchased*, 1868.

67506. Entirely septate example, 37·5 mm. in diameter; locality not recorded. *Coll. of late Alex. Bryson, Esq.*

67800. Five septate examples, ranging in diameter from 16 to 35·5 mm.; locality not recorded. *Purchased*, 1869.

75127 a. Five specimens, ranging in diameter from 17 to 41·5 mm.; Westmoreland. *Toulmin-Smith Coll.*

75129. Five more or less imperfect specimens, ranging in diameter from 12 to 33 mm.; Yorkshire. *Toulmin-Smith Coll.*

75348. Two examples, 23 and 42 mm. in diameter respectively; Caldbeck, Cumberland. *History unknown.*

97358. Four septate examples, ranging in diameter from 25·5 to 30 mm.; one specimen more globose than the rest; locality not recorded.
Presented on behalf of the late Mr. John Rofe, 1878.

97361. Well-preserved wholly septate specimen, 41 mm. in diameter, exhibiting the ornaments of the test; locality not recorded.
Presented on behalf of the late Mr. John Rofe, 1878.

C. 282. Five well-preserved specimens, ranging in diameter from 30 to 62 mm., one (C. 282 *a*) is Phillips's type (*l. c.* pl. xix. ff. 7–9); Bolland, Yorkshire. *Gilbertson Coll.*

C. 283. Two examples, 43 and 50 mm. in diameter respectively, exhibiting the suture-line, the larger one also the test; locality not recorded. *Gilbertson Coll.*

C. 284. Two well-preserved entirely septate examples, 17 and 33·5 mm. in diameter respectively, somewhat more inflated than the type, clearly exhibiting the ornaments of the test; locality not recorded. *Gilbertson Coll.*

C. 285. Two examples, 15·5 and 22 mm. in diameter respectively, also more inflated than the type; Bolland, Yorkshire.
Gilbertson Coll.

C. 321. Fairly well-preserved specimen, 66 mm. in diameter, the whole of the last whorl occupied by the body-chamber; locality not recorded. *Purchased*, 1882.

C. 1608. Example, 45 mm. in diameter, on the weathered surface of a small block, exhibiting the sculpture of the test; Swimbridge, N. Devon. *Purchased*, 1886.

C. 1658. Two examples, each 29 mm. in diameter, more inflated than the type. They are labelled "*Goniatites hemisphæricus.*" Wetton, Staffordshire.

Presented by John Edward Lee, Esq., 1885.

C. 1659. Imperfect specimen, 35·5 mm. in diameter, possibly belonging to this species; test nearly smooth; Hill Bolton, near Thorpe.

Presented by John Edward Lee, Esq., 1885.

C. 1938. Entirely septate example, 51 mm. in diameter, displaying the suture-line; locality not recorded. *Purchased*, 1887.

C. 2499. Bisected specimen, 27 mm. in diameter; locality not recorded. *History unknown.*

C. 3046. Septate example, 16 mm. in diameter, bearing fragments of the test; Lancashire.

Presented by Frederick Harford, Esq., 1889.

C. 4955. Well-preserved specimen, 28·5 mm. in diameter, wanting the test; Yorkshire. *History unknown.*

C. 5079. Septate example, 13 mm. in diameter, with portions of the test; Todmorden. *History unknown.*

C. 5080. Well-preserved specimen, 43 mm. in diameter, with a portion of the test showing the ornaments; its suture-line is depicted in fig. 76 (p. 161); Bolland.

History unknown.

C. 5081. Example, 24·5 mm. in diameter, showing ornaments of test; Todmorden. *History unknown.*

C. 5082, C. 5083. Inflated septate specimen, 21·5 mm. in diameter; and an imperfect specimen, 48 mm. in diameter; Bolland.

History unknown.

C. 5084. Six fairly well-preserved examples, ranging in diameter from 15·5 to 32·5 mm.; Grund.

Transferred from Mus. Pract. Geol.

C. 5085–88. Five specimens, ranging from 12 to 54 mm. in diameter; one bisected and one moiety polished; localities not recorded. *History unknown.*

C. 5089. Water-worn example, 16 mm. in diameter, from the Drift, Lexden, Essex. *History unknown.*

(ii) *Culm*.

The following specimens were presented by John Edward Lee, Esq., 1885:—

C. 610 a, C. 1638 b. Five small slabs with crushed specimens exhibiting the sculpture of this species; Waddon Barton.

C. 1641. Two slabs; Bampton, Devon.

C. 1642 a. One slab; Marburg, Nassau.

C. 1647. Five examples, ranging in diameter from 13 to 53 mm.; Hagen, Westphalia.

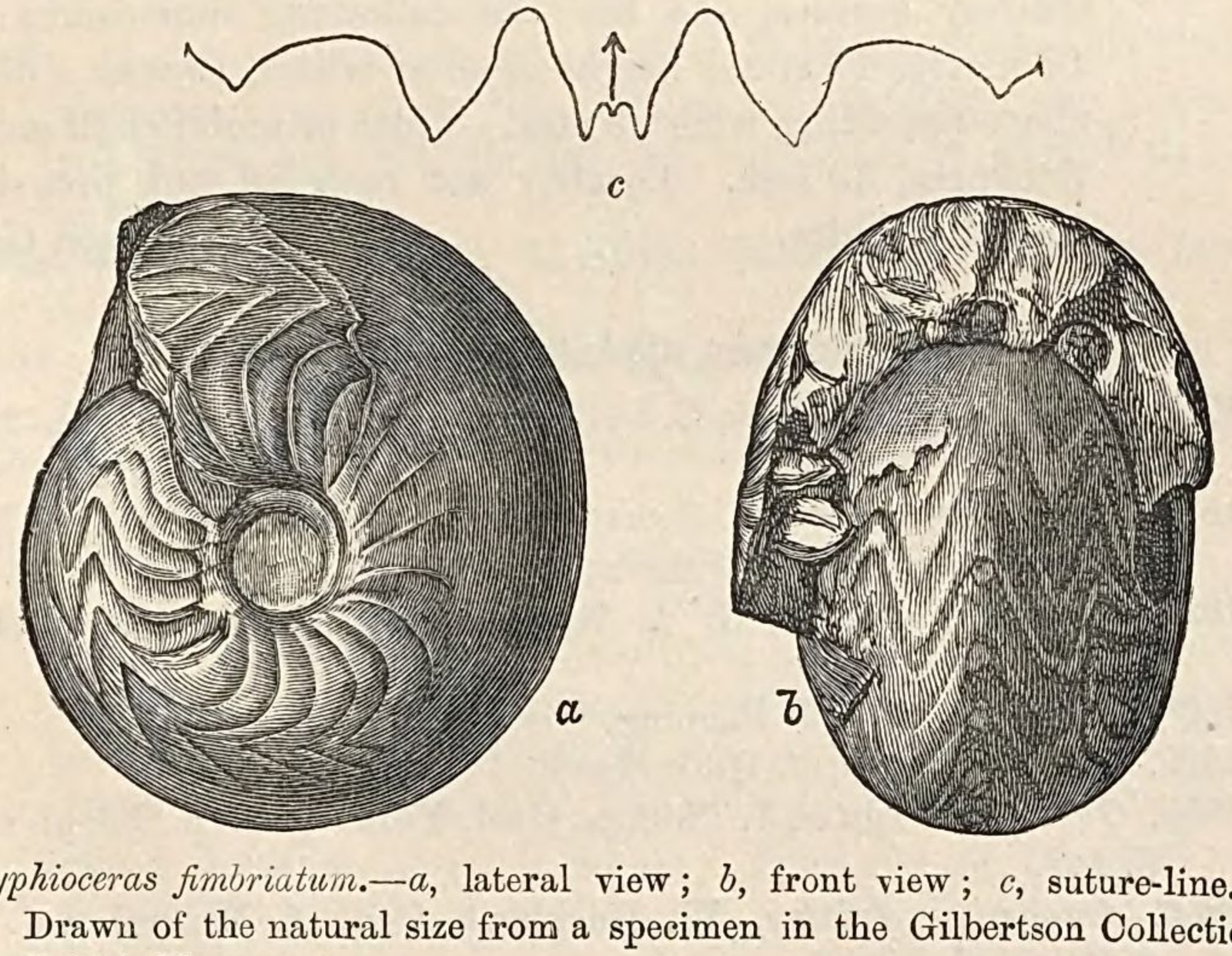
C. 1851. Small slab with impression of shell about 18 mm. in diameter, possibly referable to this species; Herborn, Nassau.

C. 2041 a. One slab; Waddon Barton.

Glyphioceras fimbriatum, sp. nov.

Sp. Char. Shell subglobose, somewhat compressed, umbilicated; greatest thickness at the margin of the umbilicus, about two-thirds

Fig. 77.



Glyphioceras fimbriatum.—*a*, lateral view; *b*, front view; *c*, suture-line.—Drawn of the natural size from a specimen in the Gilbertson Collection, British Museum.

of the diameter of the shell; height of outer whorl about three-sevenths of the diameter of the shell. Whorls (? number); inclusion about six-sevenths; umbilicus about one-fifth of the diameter of the

shell in width, with subangular margin, step-like sides, exposing part of the inner whorls. Whorl semilunate in section, wider than high; indented to a little more than one-half of its height by the preceding whorl; periphery broadly convex; sides feebly convex, somewhat flattened, especially near the umbilicus; inner area narrow, well-defined, nearly perpendicular to the plane of symmetry. Length of body-chamber and aperture not seen. Chambers shallow, about twenty in a whorl; suture-line as in fig. 77 *c*. Test rather thick, composed of two layers, the inner thin and with a smooth surface, the outer thicker and its surface ornamented with delicate fimbriated striæ which are but slightly backwardly-deflected in crossing the periphery; in the adult these lines are very obscure and the test nearly smooth.

Its sculpture and smaller umbilicus distinguish this species from *Gly. sphæroidale*; its open umbilicus and coarser sculpture distinguish it from *Gly. crenistria*; while its sculpture, less inflated form, and wider umbilicus serve to separate it from *Gly. sphæricum*.

Size. Shell attaining a diameter of more than 55 mm.

Form. & Loc. Carboniferous Limestone; locality not recorded.

C. 284 a. Four well-preserved examples ranging in diameter from 16 to 44 mm. The largest (represented in fig. 77) is entirely septate, and has the following dimensions:— Diameter, 44 mm.; height of outer whorl, 19 mm.; ditto above preceding whorl, 9 mm.; width of umbilicus 9 mm.; thickness, 30 mm. Locality not recorded, but probably from Yorkshire. *Gilbertson Coll.*

Glyphioceras striatum (J. Sowerby).

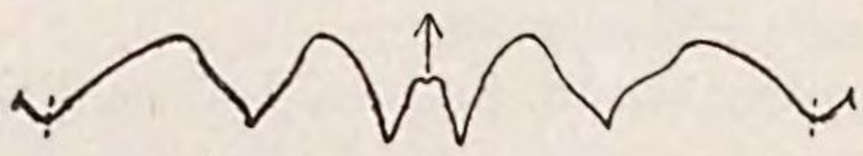
1749. A beautiful *Nautilites*, C. Lyttleton, Phil. Trans. vol. xlv. p. 320, f. 2.
1814. *Ammonites striatus*, J. Sowerby, Min. Con. vol. i. p. 115, pl. liii. f. 1 (*not* Reinecke, *nor* Münster).
1825. *Goniatites striatus*, G. de Haan, Monog. Ammon. et Goniat. p. 159.
1828. *Orbulita striata*, J. Fleming, Hist. Brit. Anim. p. 248.
1829. *Globites striatus*, F. Holl, Handb. Petrefact. p. 227.
1836. *Goniatites striatus*, J. Phillips, Geol. Yorks. pt. ii. p. 233, pl. xix. ff. 1–3.
1836. *Ammonites striatus*, W. Buckland, Geol. & Mineral. vol. ii. p. 60, pl. xl. f. 2.
1838. *Ammonites striatus*, L. Agassiz, in Desor's translation of Sowerby's Min. Con. vol. i. p. 27, pl. xxvi.
1842–44. *Ammonites striatus* (pars), L. G. de Koninck, Descrip. Anim. Foss. p. 568, pl. xlix. ff. 7 *a*, *b*, *c*, *d*; pl. l. ff. 7 *a*, *b*, *c*.

1842. *Goniatites striatus*, G. B. Sowerby, Conch. Man. p. 309, f. 480.
1843. *Goniatites striatus*, J. Morris, Cat. Brit. Foss. p. 180.
1843. *Goniatites striatus*, J. E. Portlock, Geol. Londonderry, p. 407.
1844. *Goniatites striatus*, F. M'Coy, Synop. Carb. Foss. Ireland, p. 16.
? 1846. *Goniatites sphæricus* (pars), F. A. Quenstedt, Petrefact. Deutsch. vol. i. (Cephalopoden), p. 66, pl. iii. ff. 10 *a–d* (excl. f. 11).
1848. *Goniatites striatus* (pars), H. G. Bronn, Gesch. d. Natur, vol. iii. p. 545.
1850. *Aganides striatus* (pars), A. d'Orbigny, Prod. de Paléont. stratigr. vol. i. p. 115.
1852. *Ammonites sphaericus* (pars), C. G. Giebel, Fauna der Vorwelt, vol. iii. p. 471.
1854. *Goniatites striatus*, J. Morris, Cat. Brit. Foss. 2nd ed. p. 304.
1852–54. *Goniatites sphaericus* (pars), F. Roemer in H. G. Bronn's Lethæa Geogn. 3rd ed. vol. i. pt. 2, p. 517, pl. i.[1] ff. 17 *a, b, c.*
1855. *Aganides sphæricus*, var. *γ. striatus*, F. M'Coy, Brit. Pal. Foss. p. 567.
1855–57. *Goniatites striatus*, J. Kelly, Journ. Geol. Soc. Dublin, vol. vii. p. 7.
1864. *Goniatites striatus*, J. W. Salter, Mem. Geol. Surv., Geol. country around Oldham, p. 59.
1876. *Goniatites sphaericus*, F. Roemer, Lethæa Palæozoica, pl. xlvi. ff. 11 *a, b, c.*
1876. *Goniatites striatus*, J. Armstrong, J. Young, and D. Robertson, Cat. West. Scottish Foss. p. 59.
1880. *Goniatites striatus* (pars), L. G. de Koninck, Faune Calc. Carb. Belgique (Ann. Mus. Roy. d'Hist. nat. Belgique, sér. Paléont. vol. v.), pt. ii. p. 101, pl. xlvi. ff. 1, 1 *a*, 2, 2 *a*; pl. xlvii. ff. 1, 1 *a*, 2, 2 *a*.
1884. *Glyphioceras striatum*, A. Hyatt, Proc. Boston Soc. Nat. Hist. vol. xxii. p. 329.
1888. *Goniatites striatus*, R. Etheridge, Brit. Foss. vol. i., Palæozoic, p. 313.
1890. *Glyphioceras striatum*, G. Steinmann & L. Döderlein, Elem. d. Paläont. p. 393.
[*Not* 1818. *Ammonites striatus*, Reinecke, Maris protogaei Nautilos et Argonautas, pl. viii. ff. 65, 66.—1839. *Goniatites striatus*, G. Münster, Beiträge zur Petrefactenkunde, i. p. 20.—1843. *Goniatites striatus*, G. Münster, *ibid.* i. 2nd ed. p. 46.—1843. *Goniatites striatus*, F. A. Roemer, Verstein. Harzgeb. p. 34, pl. ix. f. 11.—1878. *Goniatites striatus*, H. Abich, Geol. Forsch. in den Kaukasischen Ländern, pt. i. p. 9, pl. i. ff. 1, 1 *a*, 2, 2 *a*, 3; pl. xi. ff. 2, 2 *a*.]

Sp. Char. Shell subglobose, somewhat compressed, adult with eight sinuous constrictions feebly marked on the outer surface of the test, but very distinct on internal casts; greatest thickness at the margin of the umbilicus, five-eighths of the diameter of the

shell; height of outer whorl rather more than three-sevenths of the diameter of the shell. Whorls six to eight; inclusion almost complete; umbilicus rather small, exposing the edges of the inner whorls, about one-sixth of the diameter in width. Whorl semi-lunate in section, wider than high; indented to nearly two-thirds of its height by the preceding whorl; periphery broadly convex; sides feebly convex, somewhat flattened; inner area nearly perpendicular to the plane of symmetry, slightly concave. Body-chamber occupying a complete whorl; aperture not seen. Chambers not very deep, about twenty in a whorl in an adult shell; suture-line as in fig. 78. Test thin, with fine spiral striæ which in the adult shell are crossed by transverse sinuous incised lines forming a wide forwardly-concave sinus on the periphery; it is thickened at intervals so as to produce well-marked constrictions on internal casts. ('Wrinkle-layer' composed of minute, coarse, wavy, anastomosing rugæ[1].)

Fig. 78.



Suture-line of *Glyphioceras striatum*. Drawn of the natural size from Sowerby's type-specimen in the British Museum Collection.

Size. Shell attaining a diameter of 85 mm.

Form. & Loc. Carboniferous Limestone. *British*: Derbyshire; Bolland, Yorkshire; Fremington, N. Devon. *Foreign*: Visé, Belgium.

26569. Example, 31 mm. in diameter, somewhat more inflated than the type, with fragments of the test showing ornaments; Bolland. *Presented by Dr. Bigsby.*

33451. Fine specimen, 58 mm. in diameter, showing suture-line and the ornaments of the test; Derbyshire.

43870. Sowerby's type-specimen, 41 mm. in diameter; it is entirely septate and exhibits 15 chambers in the outer whorl; Derbyshire. *Sowerby Coll.*

51395. Entirely septate example, 25 mm. in diameter; Bolland. *Morris Coll.*

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[1] This description of the 'wrinkle-layer' is based upon the specimen no. C. 1939, which is referred somewhat doubtfully to this species.

64767. Elliptical distorted specimen, showing the ornaments of the test; its longest diameter is 80 mm.; Visé.
Purchased, 1868.

64852. Eight examples, ranging in diameter from 6·5 to 16 mm.; the largest displaying the ornaments of the test; Visé.
Purchased, 1868.

73811. One moiety of a bisected specimen, polished; bearing fragments of the test; Derbyshire. *History unknown.*

C. 239. Three fairly well-preserved specimens, 66·5, 70, and 85 mm. in diameter respectively; also one moiety of a bisected specimen, about 60 mm. in diameter, polished; Bolland. *Gilbertson Coll.*

C. 1610 a. Pyritized example, entirely septate, 36 mm. in diameter; Fremington, N. Devon. *Purchased*, 1886.

C. 1939. Imperfect specimen, 42·5 mm. in diameter, broken so as to show the 'wrinkle-layer' very clearly; locality not recorded. *Purchased*, 1887.

C. 5312. Imperfect example, showing inner whorls, possibly belonging to this species; locality not recorded.
History unknown.

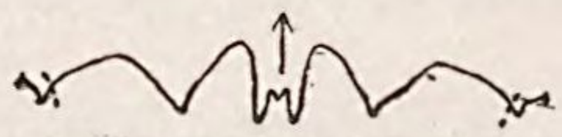
Glyphioceras obtusum (J. Phillips).

1813. *Ellipsolites ovatus*, J. Sowerby, Min. Con. vol. i. p. 83, pl. xxxvii. (imperfectly defined).
1822. *Nautellipsites ovatus*, J. Parkinson, Introd. Foss. Org. Rem. pp. 164 & 233.
1825. *Goniatites ovatus*, G. de Haan, Monog. Ammon. et Goniat. p. 148.
1829. *Globites ovatus*, F. Holl, Handb. d. Petrefact. p. 226.
1836. *Goniatites obtusus*, J. Phillips, Geol. Yorks. pt. ii. p. 234, pl. xix. ff. 10, 11, ? 13 (not f. 12 = *Glyphioceras Phillipsi*).
1838–45. *Nautilus ovatus*, L. Agassiz, in Desor's translation of Sowerby's Min. Con. vol. i. pp. 27 & 65, pl. xxxvii.
1843. *Goniatites obtusus*, J. Morris, Cat. Brit. Foss. p. 180.
1844. *Goniatites obtusus*, F. M'Coy, Synop. Carb. Foss. Ireland, p. 15.
1848. *Goniatites obtusus*, J. H. Cumming, Isle of Man, p. 357.
1848. *Goniatites obtusus* (pars), H. G. Bronn, Gesch. d. Natur, vol. iii. p. 543.
1850. *Aganides obtusus*, A. d'Orbigny, Prod. de Paléont. stratigr. vol. i. p. 115.
1852. *Ammonites sphaericus* (pars), C. G. Giebel, Fauna der Vorwelt, vol. iii. p. 471.

1854. *Goniatites obtusus*, J. Morris, Cat. Brit. Foss. 2nd ed. p. 304.
1855–57. *Goniatites obtusus*, J. Kelly, Journ. Geol. Soc. Dublin, vol. vii. p. 7.
1878. *Goniatites obtusus*, G. A. Lebour, Geol. Northumberland, p. 67.
1880. *Goniatites obtusus*, L. G. de Koninck, Faune Calc. Carb. de la Belgique (Ann. Mus. Roy. d'Hist. nat. de Belgique, sér. Paléont. vol. v.), pt. ii. p. 104, pl. xlvi. f. 3, pl. xlvii. f. 10.
1884. *Glyphioceras obtusum*, A. Hyatt, Proc. Boston Soc. Nat. Hist. vol. xxii. p. 329.
1888. *Goniatites obtusus*, R. Etheridge, Brit. Foss. vol. i., Palæozoic, p. 312.

Sp. Char. Shell subglobose, involute; greatest thickness at the umbilical margin, rather more than one-half of the diameter of the shell; height of outer whorl about four-sevenths of the diameter of the shell. Whorls (? number); inclusion almost complete; umbilicus very small, infundibuliform, almost closed, with rounded margin. Whorl semielliptical in section, rather higher than wide; indented to about one-half of its height by the preceding whorl; periphery broadly convex, somewhat flattened; sides feebly convex, flattened; inner area very narrow. Body-chamber occupying at least five-sixths of the last whorl. Chambers not very deep, about fourteen in a whorl; suture-line as in fig. 79. Test nearly smooth, ornamented with very fine sinuous lines of growth, which are strongly arched forward near the periphery, and form on the latter a deep wide sinus; they are sometimes accompanied by narrow, feebly-marked folds.

Fig. 79.



Suture-line of *Glyphioceras obtusum*. Drawn of the natural size from Phillips's type-specimen in the Gilbertson Collection, British Museum (no. C. 247 *a*).

After careful examination of the two specimens figured by Phillips, both of which are in the National Collection, we are disposed to regard them as specifically distinct; we have selected the original of Phillips's pl. xix. f. 10 as the type of his *obtusus*, and have named the other species *Glyphioceras Phillipsi*, selecting the original of Phillips's pl. xix. f. 12 as the type.

Size. Shell probably attaining a diameter of at least 75 mm.

Form. & Loc. Carboniferous Limestone: Yorkshire; Ireland.

30240. A somewhat imperfect specimen, 53 mm. in diameter; locality not recorded. *Dixon Coll.*

33409. An entirely septate pyritized specimen, 21 mm. in diameter; locality not recorded.

Presented by J. D'Urban, Esq., 1854.

43872. Sowerby's type-specimen of *Ellipsolites ovatus* (Min. Con. vol. i. p. 83, pl. xxxvii.), its diameters being 73 and 58 mm. respectively; Blackrock, co. Cork, Ireland.

Sowerby Coll.

[6]5185. Two elliptically crushed examples, whose longer diameters are 45 and 60 mm. respectively; Blackrock, co. Cork.

Purchased, 1868.

65186. Two pyritized much decomposed specimens, 20 and 22 mm. in diameter respectively, probably belonging to this species; Old Head, Kinsale. *Purchased*, 1868.

97359, 97362, 97366. An abraded entirely septate internal cast, 33 mm. in diameter, possibly referable to this species; and two other specimens, 26 and 32 mm. in diameter respectively, probably belonging to this species: locality not recorded.

Presented on behalf of the late Mr. John Rofe, 1878.

C. 241 b. Two examples, 30 and 33 mm. in diameter respectively; locality not recorded. *Gilbertson Coll.*

C. 247. Three examples, 17, 23, and 36 mm. in diameter respectively, the medium-sized specimen (marked *a*) being the example figured by Phillips, *op. cit.* pl. xix. f. 10; Black Hall, Bolland, Yorkshire. *Gilbertson Coll.*

C. 250. A fairly well-preserved internal cast, 50 mm. in diameter, probably belonging to this species; locality not recorded.

Gilbertson Coll.

C. 552. An imperfect specimen, about 30 mm. in diameter; Ireland. *Purchased*, 1884.

C. 3147. Three internal casts, each about 40 mm. in diameter, one in matrix; Ireland. *Presented by Mrs. Leifchild*, 1890.

C. 4700. Two elliptical crushed specimens, whose diameters are respectively 65 and 41, 71 and 47 mm.; locality not recorded. *Purchased*, 1894.

C. 5387. An imperfect example, 26 mm. in diameter; Bolland.

History unknown.

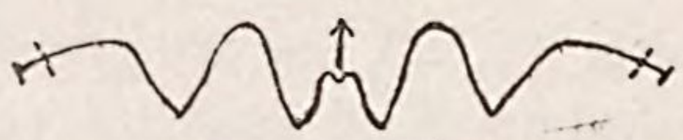
C. 5390. An imperfect specimen, 28·5 mm. in diameter, probably belonging to this species. The body-chamber occupies the last two-thirds of the outer whorl and displays the epidermids as very minute irregularly placed punctæ. The external saddle is more rounded than in the type. Bolland. *History unknown.*

Glyphioceras Phillipsi, sp. nov.

1836. *Goniatites obtusus* (pars), J. Phillips, Geol. Yorks. pt. ii. p. 234, pl. xix. f. 12 (not 10, 11, 13 = *Glyphioceras obtusum*).

Sp. Char. Shell discoidal, compressed, involute; greatest thickness at the umbilical margin, rather less than one-half of the diameter of the shell; height of outer whorl about one-half of the diameter of the shell. Whorls (? number); inclusion nearly complete; umbilicus deep, narrow, about one-tenth of the diameter of the shell, infundibuliform, with subangular margin. Whorl oval in section, about as wide as high; indented to about one-third of its height by the preceding whorl; periphery narrowly convex; sides flattened; inner area narrow, sloping towards the umbilicus. Body-chamber (? length). Chambers rather shallow, seventeen or eighteen in a whorl; suture-line as in fig. 80. Test thin, ornamented

Fig. 80.



Suture-line of *Glyphioceras Phillipsi*. Drawn of the natural size from a specimen in the British Museum Collection (C. 5099 *a*).

with very fine striæ, which are slightly waved on the sides, curved forward near the periphery, and on the latter bent backwards so as to form a deep broad sinus.

This species is more compressed and has a more prominent umbilical margin than *G. obtusum*, with which it was united by Phillips. It somewhat resembles *G. diadema*, but is more compressed, and has a narrower umbilicus wanting the prominent angular margin. Its suture-line distinguishes it from *G. micronotum*.

Size. Shell attaining a diameter of more than 35 mm.

Form. & Loc. Carboniferous: Yorkshire.

C. 241 a. One of the specimens figured by Phillips (*op. cit.* pl. xix. f. 12) as *G. obtusus*. It is exceedingly well-preserved,

and shows the ornaments of the test. There is no trace of the suture-line, but the form of the shell agrees very closely with the specimen no. C. 5099 *a*, from which fig. 80 has been drawn. Locality not recorded. *Gilbertson Coll.*

C. 265 a. A partially crushed example, 19·5 mm. in diameter, showing the suture-line and the ornaments of the test; High Green Wood. *Gilbertson Coll.*

C. 5099 a. Entirely septate example, 31·5 mm. in diameter, the last two septa very approximate; High Green Wood. *History unknown.*

C. 5295. Three specimens, ranging in diameter from 8·5 to 14 mm., probably referable to this species; Halifax. *Purchased*, 1895.

C. 5296 b, C. 5300. A partially crushed example, 19 mm. in diameter, and a fairly well-preserved specimen, 36 mm. in diameter, probably belonging to this species; Halifax. *Purchased*, 1895.

C. 5378. Moderately well-preserved example, 33 mm. in diameter; locality not recorded. *History unknown.*

Glyphioceras micronotum (J. Phillips).

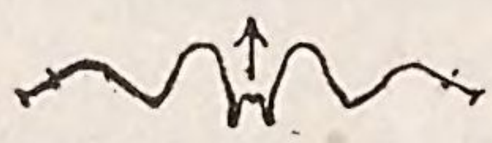
[Fig. 74, ante, p. 156.]

1836. *Goniatites micronotus*, J. Phillips, Geol. Yorks. pt. ii. p. 234, pl. xix. ff. 22, 23.
1843. *Goniatites micronotus*, J. Morris, Cat. Brit. Foss. p. 180.
1844. *Goniatites micronotus*, F. M'Coy, Synop. Carb. Foss. Ireland, p. 14.
1848. *Goniatites micronotus*, J. H. Cumming, Isle of Man, p. 357.
1848. *Goniatites micronotus*, H. G. Bronn, Gesch. d. Natur, vol. iii. p. 543.
1850. *Aganides micronotus*, A. d'Orbigny, Prod. de Paléont. stratigr. vol. i. p. 115.
1852. *Ammonites micronotus*, C. G. Giebel, Fauna der Vorwelt, vol. iii. p. 474.
1854. *Goniatites micronotus*, J. Morris, Cat. Brit. Foss. 2nd ed. p. 304.
1855–57. *Goniatites micronotus*, J. Kelly, Journ. Geol. Soc. Dublin, vol. vii. p. 7.
1880. *Goniatites micronotus*, W. Branco, Palæontographica, vol. xxvii. p. 24, pl. iv. f. iv. *a–l*.
1884. *Glyphioceras micronotum*, A. Hyatt, Proc. Boston Soc. Nat. Hist. vol. xxii. p. 329.
1888. *Goniatites micronotus*, R. Etheridge, Brit. Foss. vol. i. Palæozoic, p. 312.

1889. *Glyphioceras micronotum*, E. Holzapfel, Palæont. Abhandl., Dames & Kayser, vol. v. 1, p. 28, pl. ii. f. 1.

Sp. Char. Shell discoidal, compressed, involute; greatest thickness at the umbilical margin, about one-half of the diameter of the shell; height of outer whorl a little more than one-half of the diameter of the shell. Whorls (? number); inclusion almost complete; umbilicus narrow, about one-twelfth of the diameter of the shell, infundibuliform, with subangular margin. Whorl semielliptical in section, a little higher than wide; indented to three-sevenths of its height by the preceding whorl; periphery narrowly convex; sides feebly convex, flattened; inner area narrow, sloping towards the umbilicus, somewhat flattened. Body-chamber occupying at least two-thirds of the last whorl. Chambers shallow, about nine in the last half whorl preceding the body-chamber; suture-line as in fig. 81.

Fig. 81.



Suture-line of *Glyphioceras micronotum*. Drawn of the natural size from Phillips's type-specimen in the Gilbertson Collection, British Museum.

Test thin, ornamented with very fine striæ, which are slightly waved on the sides and form a deep, broad, backwardly-directed sinus on the periphery. Internal casts sometimes with four shallow constrictions having the same course as the ornaments, being deepest at the periphery and becoming very feeble near the umbilicus. Initial-chamber ellipsoidal or spindle-shaped, transversely elongate.

Size. Shell attaining a diameter of about 33 mm.

Form. & Loc. Carboniferous Limestone: Yorkshire; Staffordshire; Ireland. Carboniferous: Halifax, Yorkshire.

24764 b. An internal cast, 26 mm. in diameter; locality not recorded. *Purchased*, 1849.

26268. Imperfect specimen, 17 mm. in diameter; Kildare, Ireland. *Purchased*, 1851.

26306. An internal cast, 26 mm. in diameter, probably referable to this species; Yorkshire. *Purchased*, 1851.

75348 a. A similar specimen, 24 mm. in diameter; locality not recorded. *Purchased*, 1875.

C. 262. Two examples, 21 and 26 mm. in diameter respectively, the larger (marked *a*) being Phillips's type-specimen ; Bolland, Yorkshire. *Gilbertson Coll.*

C. 4399. Two imperfect specimens, 22 and 27 mm. in diameter respectively ; Wetton, Staffordshire. *Purchased*, 1892.

C. 5297. An example, 26 mm. in diameter, probably belonging to this species ; Halifax, Yorkshire. *Purchased*, 1895.

C. 5379. A fairly well-preserved specimen, 29 mm. in diameter ; locality not recorded. *History unknown.*

C. 5380. One specimen, 33 mm. in diameter ; locality not recorded. *History unknown.*

C. 5381. Five examples, ranging in diameter from 16 to 25 mm. ; locality not recorded. *History unknown.*

C. 5385. An entirely septate specimen, 16 mm. in diameter, showing the test and the suture-line ; Bolland. *History unknown.*

C. 5386. An imperfect example, 22 mm. in diameter, showing the sculpture of the test ; Vale of Todmorden. *History unknown.*

Glyphioceras truncatum (J. Phillips).

1836. *Goniatites truncatus*, J. Phillips, Geol. Yorks. pt. ii. p. 223, pl. xix. ff. 20, 21.
1843. *Nautilus perplanatus*, J. E. Portlock, Rep. Geol. Londonderry, p. 403, pl. xxix A. f. 11.
1843. *Goniatites truncatus*, J. Morris, Cat. Brit. Foss. p. 180.
1844. *Goniatites truncatus*, F. M'Coy, Synop. Carb. Foss. Ireland, p. 16.
1848. *Goniatites truncatus*, J. H. Cumming, Isle of Man, p. 357.
1848. *Goniatites truncatus*, H. G. Bronn, Gesch. d. Natur, vol. iii. p. 545.
1850. *Aganides truncatus*, A. d'Orbigny, Prod. de Paléont. stratigr. vol. i. p. 115.
1852. *Ammonites truncatus*, C. G. Giebel, Fauna der Vorwelt, vol. iii. p. 474.
1854. *Goniatites truncatus*, J. Morris, Cat. Brit. Foss. 2nd ed. p. 305.
1854. *Nautilus perplanatus*, J. Morris, ibid. p. 308.
1855–57. *Goniatites truncatus*, J. Kelly, Journ. Geol. Soc. Dublin, vol. vii. p. 7.
1862. *Goniatites truncatus*, R. Griffith, Journ. Geol. Soc. Dublin, vol. ix. p. 56.
1864. *Goniatites truncatus*, J. W. Salter, Mem. Geol. Surv., Geol. country around Oldham, p. 59.

1878. *Goniatites truncatus*, G. A. Lebour, Geol. Northumberland, p. 68.

1880. *Goniatites truncatus*, L. G. de Koninck, Faune Calc. Carb. Belgique (Ann. Mus. Roy. d'Hist. nat. Belgique, sér. Paléont. vol. v.), pt. ii. p. 108, pl. xlvi. f. 5; pl. xlviii. ff. 1, 2, 3; pl. xlix. f. 7; pl. l. f. 2.

1884. *Munsteroceras truncatum*, A. Hyatt, Proc. Boston Soc. Nat. Hist. vol. xxii. p. 326.

1888. *Goniatites truncatus*, R. Etheridge, Brit. Fossils, vol. i. Palæozoic, p. 313.

1889. *Glyphioceras truncatum*, E. Holzapfel, Palæont. Abhandl., Dames & Kayser, vol. v. 1, p. 26, pl. i. ff. 8, 9.

1890. *Muensteroceras truncatum*, G. Steinmann & L. Döderlein, Elem. d. Paläont. pt. ii. p. 393.

1895. *Goniatites truncatus*, G. H. Morton, Proc. Liverpool Nat. Field-Club for 1894, p. 24.

[*Not* 1854. *Goniatites truncatus*, F. A. Roemer, Palæontogr. vol. iii. p. 94, pl. xiii. f. 30.—1884. *Glyphioceras truncatum*, A. Hyatt, Proc. Boston Soc. Nat. Hist. vol. xxii. p. 329.]

Sp. Char. Shell rather large, much compressed, discoidal, involute; greatest thickness at about one-third of the height of the whorl from the edge of the umbilicus, rather more than one-third of the diameter of the shell; height of outer whorl one-half of the diameter of the shell. Whorls eight or nine; inclusion nearly complete; umbilicus shallow, narrow, from one-eighth to one-ninth of the diameter of the shell in width. Whorl subquadrangular in section, about one-third higher than wide; indented to nearly one-third of its height by the preceding whorl; periphery feebly convex, flattened, about two-fifths of the height of the whorl in width, with subangular margins; sides feebly convex, flattened; inner area feebly convex, not marked off from the sides. Body-chamber occupying a complete whorl; aperture with a deep lateral, and a deep peripheral, sinus. Chambers rather deep, about eleven or twelve in a whorl; suture-line as in fig. 82. Test thin, ornamented with fine sigmoidal lines

Fig. 82.

Suture-line of *Glyphioceras truncatum*. Drawn of the natural size from Phillips's type-specimen in the Gilbertson Collection, British Museum.

of growth, which are strongly arched forward near the periphery, on which they form a deep wide sinus.

Size. Shell attaining a diameter of 96 mm.

Form. & Loc. Carboniferous Limestone: Westmoreland; Yorkshire; Northumberland; Fifeshire; Ireland.

26307. Well-preserved internal cast, 33 mm. in diameter, probably belonging to this species; Kildare. *Purchased*, 1851.

30216. Two fairly well-preserved internal casts, 41 and 47 mm. in diameter respectively, the smaller showing the last six loculi and a large portion of the body-chamber; Kildare. *Purchased*, 1852.

75127. Six more or less imperfect specimens, ranging in diameter from 23 to 42 mm., some showing the test, others the suture-line; Westmoreland. *Toulmin-Smith Coll.*

75128. Four examples, ranging in diameter from 45 to 82 mm.; Bolland, Yorkshire. *Toulmin-Smith Coll.*

97355, 97367. Two specimens, 36 and 58 mm. in diameter respectively, the larger probably referable to this species, the smaller entirely septate; locality not recorded. *Presented on behalf of the late Mr. John Rofe*, 1878.

C. 240. Seven specimens, ranging in diameter from 19 to 96 mm.; one being Phillips's type. Phillips's figure is somewhat reduced and restored; the specimen is 52·5 mm. in diameter and bears only fragments of the test. Bolland. *Gilbertson Coll.*

C. 241. Fragment of outer whorl, displaying inner whorls up to a diameter of about 15 mm.; locality not recorded. *Gilbertson Coll.*

C. 1648. A well-preserved specimen, 52·5 mm. in diameter, somewhat stouter and more widely umbilicated than the type; Redesdale (Ironstone shale), Northumberland. *Presented by John Edward Lee, Esq.*, 1885.

C. 4633. Example, 28·5 mm. in diameter; Ireland. *Purchased*, 1893.

C. 4917. Lateral aspect of portion of specimen about 49 mm. in diameter on surface of small slab; Lesley Quarry, Fife. *Purchased*, 1891.

C. 5314. Fairly well-preserved example, 32·5 mm. in diameter somewhat stouter than the type; near Woodburn, Northumberland. *History unknown.*

Glyphioceras vesica (J. Phillips).

1836. *Goniatites vesica*, J. Phillips, Geol. Yorks. pt. ii. p. 236, pl. xx. ff. 19–21.
1843. *Goniatites vesica*, J. Morris, Cat. Brit. Foss. p. 180.
1848. *Goniatites vesica*, H. G. Bronn, Gesch. d. Natur, vol. iii. p. 546.
1850. *Aganides vesica*, A. d'Orbigny, Prod. de Paléont. stratigr. vol. i. p. 115.
1852. *Ammonites vesica*, C. G. Giebel, Fauna der Vorwelt, vol. iii. p. 470.
1854. *Goniatites vesica*, J. Morris, Cat. Brit. Foss. p. 305.
1855–57. *Goniatites vesica*, J. Kelly, Journ. Geol. Soc. Dublin, vol. vii. p. 7.
? 1880. *Goniatites* cf. *vesica*, W. Branco, Palæontogr. vol. xxvii. pl. v. f. 2.
1888. *Goniatites vesica*, R. Etheridge, Brit. Foss. vol. i., Palæozoic, p. 313.

Sp. Char. Shell subglobose, involute; greatest thickness at a short distance from the edge of the umbilicus, about seven-ninths of the diameter of the shell; height of outer whorl about one-half of the diameter of the shell. Whorls (? number); inclusion nearly complete; umbilicus small, deep, with subangular margin. Whorl semilunate in section, its height about four-sevenths of its width; indented to nearly two-thirds of its height by the preceding whorl; periphery broadly convex, continuous with the convex sides, which are slightly depressed around the umbilicus; inner area narrow, fairly well-defined, very steep. Body-chamber occupying fully a complete whorl. Chambers rather shallow, fourteen or fifteen in a whorl; suture-line as in fig. 83. Test thin, with delicate lines of

Fig. 83.

Suture-line of *Glyphioceras vesica*? Drawn from a specimen in the Gilbertson Collection, British Museum, $\times \frac{3}{2}$.

growth which form a broad but very shallow sinus on the periphery and are raised into obscure folds at the margin of the umbilicus. The initial-chamber in an example which Branco compares with this species is transversely ovoid.

Unfortunately Phillips's type-specimen exhibits neither the suture-line nor the sculpture of the test, and it is quite possible that more than one species may be included among the specimens enumerated below. The very inflated examples such as Phillips selected as his

type are apparently not common, and we have not been able to see the suture-line in any example that we can identify with certainty with Phillips's type. Although closely resembling Phillips's figure, the suture-line here given may possibly belong to a species that subsequently may be found to be intermediate between *Gly. vesica* and *Gly. implicatum*. A specimen in the Gilbertson Collection closely resembling the type has a suture-line and shell-ornaments which indicate affinities with *Gly. crenistria*.

This species is related to *Gly. implicatum*, but is much more inflated, its umbilical margin is more rounded, and its lines of growth form a shallower and broader sinus on the periphery; from *Gly. sphæricum* it is distinguished by its smaller size, its less inflated shell, and the depression around its umbilicus.

Size. Shell attaining a diameter of about 20 mm.

Form. & Loc. Carboniferous Limestone: Yorkshire and Lancashire.

51392 a. A well-preserved internal cast, 14 mm. in diameter; Bolland, Yorkshire. *Purchased*, 1867.

97357 c. Four more or less imperfect specimens, each about 11 mm. in diameter, two exhibiting the suture-line; locality not recorded.
Presented on behalf of the late Mr. John Rofe, 1878.

C. 280. Eleven fairly well-preserved examples, ranging in diameter from 8 to 20 mm., some showing the test, others the suture-line, one being Phillips's type-specimen; two or three of these specimens are less inflated than the rest, and may possibly belong either to the next species or to a species intermediate between that and the present one: Black Hall, Bolland, Yorkshire. *Gilbertson Coll*

C. 282 d, e. Two examples, 6 and 10 mm. in diameter respectively; locality not recorded. *Gilbertson Coll.*

C. 653. Two specimens, 14·5 and 17·5 mm. in diameter respectively; Lancashire. *Egerton Coll.*

C. 4954. Two examples, 12 and 18 mm. in diameter respectively; Todmorden, Yorkshire. *History unknown.*

C. 5315, C. 5316. Five specimens, ranging in diameter from 7 to 20 mm., the largest exhibiting the suture-line very clearly; also the inner whorls, up to a diameter of 4 mm., of another example, showing the form of the young shell: locality not recorded. *History unknown.*

Glyphioceras implicatum (J. Phillips).

1836. *Goniatites implicatus*, J. Phillips, Geol. Yorks. pt. ii. p. 235, pl. xix. ff. 24, 25.
1843. *Goniatites implicatus*, J. Phillips, Cat. Brit. Foss. p. 179.
1848. *Goniatites implicatus*, J. H. Cumming, Isle of Man, p. 357.
1848. *Goniatites implicatus*, H. G. Bronn, Gesch. d. Natur, vol. iii. p. 542.
1852. *Ammonites implicatus*, C. G. Giebel, Fauna der Vorwelt, vol. iii. p. 469.
1854. *Goniatites implicatus*, J. Morris, Cat. Brit. Foss. 2nd ed. p. 303.
1855. *Aganides implicatus*, F. M'Coy, Brit. Pal. Foss. p. 565.
1876. *Goniatites implicatus*, J. Armstrong, J. Young, & D. Robertson, Cat. West. Scottish Foss. p. 58.
1880. *Goniatites implicatus*, L. G. de Koninck, Faune du Calc. Carb. Belgique (Ann. Mus. Roy. d'Hist. nat. Belgique, sér. Paléont. vol. v.), pt. ii. p. 107, pl. l. f. 1.
1884. *Munsteroceras implicatum*, A. Hyatt, Proc. Boston Soc. Nat. Hist. vol. xxii. p. 326.
1888. *Goniatites implicatus*, R. Etheridge, Brit. Foss., vol. i. Palæozoic, p. 311.

Sp. Char. Shell inflated, involute, somewhat compressed; greatest thickness at the umbilical margin, rather more than one-half of the diameter of the shell; height of outer whorl rather more than one-half of the diameter of the shell. Whorls (? number); inclusion complete; umbilicus small, closed. Whorl semielliptical in section, rather wider than high; indented to nearly one-half of its height by the preceding whorl; periphery convex, flattened; sides feebly convex, flattened; inner area scarcely defined, feebly convex, very narrow. Body-chamber occupying a complete whorl; aperture with a deep, broad hyponomic sinus. Chambers rather shallow,

Fig. 84.

Suture-line of *Glyphioceras implicatum*. Drawn of the natural size from Phillips's type in the British Museum Collection.

fourteen or fifteen in a whorl; suture-line as in fig. 84. Test thin, with very delicate transverse striæ, which form a deep broad sinus on the periphery.

All the specimens in the Collection, excepting two which accompany the type-specimen, differ from Phillips's original in being more inflated and in having deeper chambers; in fact they are intermediate between Phillips's type of *implicatus* and that author's *vesica*, and may possibly be only sexually distinct from one or other of

these species. The type approaches very closely the young of the more inflated of the examples here referred to *G. truncatum*.

Size. Shell attaining a diameter of more than 35 mm.

Form. & Loc. Carboniferous Limestone: Yorkshire.

24764 a. Imperfect specimen, 12·5 mm. in diameter, possibly belonging to this species; locality not recorded.

Purchased, 1849.

67801. Two examples, 25 and 26 mm. in diameter respectively, one displaying the suture-line, the other the ornaments of the test; locality not recorded. *Purchased.*

97357 b. Three specimens, ranging in diameter from 10 to 18 mm.; locality not recorded.

Presented on behalf of the late Mr. John Rofe, 1878.

C. 243. Three entirely septate specimens, ranging in diameter from 13 to 19 mm., the largest (marked *a*) being Phillips's type-specimen; only the smallest specimen bears any portion of the test: Black Hall, Bolland.

Gilbertson Coll.

C. 247 b. Two examples, each 21 mm. in diameter, one showing the course of the suture-line; Black Hall, Bolland.

Gilbertson Coll.

C. 293. Well-preserved specimen, 35 mm. in diameter, showing the suture-line; Black Hall, Bolland. Also a similar specimen, 31 mm. in diameter, the locality of which is not recorded. *Gilbertson Coll.*

C. 5317. Three examples, 14, 18, and 20 mm. in diameter respectively; Todmorden. *History unknown.*

C. 5318. Three specimens, ranging in diameter from 14 to 20 mm.; locality not recorded. *History unknown.*

C. 5388. An imperfect entirely septate example, 24 mm. in diameter; Bolland. *History unknown.*

Glyphioceras mutabile (J. Phillips).

1836. *Goniatites mutabilis*, J. Phillips, Geol. Yorks. pt. ii. p. 236, pl. xx. f. 26 (*not* 24, 25).

1843. *Goniatites mutabilis*, J. Morris, Cat. Brit. Foss. p. 180.

1844. *Goniatites mutabilis*, F. M'Coy, Synop. Carb. Foss. Ireland, p. 14.

1842–44. *Ammonites mutabilis*, L. G. de Koninck, Descr. Anim. Foss. p. 573, pl. l. f. 12.

1848. *Goniatites mutabilis*, H. G. Bronn, Gesch. d. Natur, vol. iii. p. 543.
1850. *Aganides mutabilis*, A. d'Orbigny, Prod. de Paléont. stratigr. vol. i. p. 116.
1852. *Ammonites Listeri* (pars), C. G. Giebel, Fauna der Vorwelt, vol. iii. p. 475.
1854. *Goniatites mutabilis*, J. Morris, Cat. Brit. Foss. 2nd ed. p. 304.
1855–57. *Goniatites mutabilis*, J. Kelly, Journ. Geol. Soc. Dublin, vol. vii. p. 7.
1876. *Goniatites mutabilis*, J. Armstrong, J. Young, & D. Robertson, Cat. West. Scottish Foss. p. 58.
1880. *Goniatites mutabilis*, L. G. de Koninck, Faune Calc. Carb. de la Belgique (Ann. Mus. Roy. d'Hist. nat. de Belgique, sér. Paléont. vol. v.), pt. ii. p. 110, pl. l. f. 7.
1888. *Goniatites mutabilis*, R. Etheridge, Brit. Foss. vol. i. Palæozoic, p. 312.
? 1889. *Glyphioceras mutabile*, E. Holzapfel, Palæont. Abhandl., Dames & Kayser, vol. v. 1, p. 29, pl. ii. ff. 2–6.

Sp. Char. Shell small, globular; greatest thickness at the margin of the umbilicus, about seven-tenths of the diameter of the shell; height of outer whorl about one-half of the diameter of the shell. Whorls seven or eight; inclusion almost complete; umbilicus not very wide, about one-third or one-fourth of the diameter of the shell, exposing the edges of the inner whorls, becoming relatively smaller with age, deep, infundibuliform, with subangular margin. Whorl semilunate in section, wider than high; indented to more than one-half of its height by the preceding whorl; periphery broadly convex and continuous with the sides; inner area well defined, relatively wide, almost perpendicular to the plane of symmetry. Body-chamber (? length). Chambers not very shallow; suture-line as in fig. 85. Test smooth, each whorl with from four to six lightly sinuous constrictions.

Fig. 85.

Suture-line of *Glyphioceras mutabile*.
After De Koninck.

The above description is based upon the Belgian examples of this species which are in the Collection. According to Phillips, the type was in the Gilbertson Collection; but in this collection, now in the British Museum, neither the type, nor even an undoubted example of the species, has been recognized.

The suture-line given by Holzapfel (Palæont. Abhandl., Dames &

Kayser, vol. v. 1, pl. ii. f. 2*a*) differs considerably from that given by de Koninck (Faune du Calc. Carb. &c. pl. l. f. 7).

Holzapfel (*op. cit.* p. 30) considers *Gon. Browni*, M'Coy, and *Gon. sphæroidalis*, M'Coy, to be large examples of this species.

Size. Shell attaining a diameter of about 15 mm.

Form. & Loc. Calcaire de Visé (Assise VI.)=Carboniferous Limestone: Visé, Belgium.

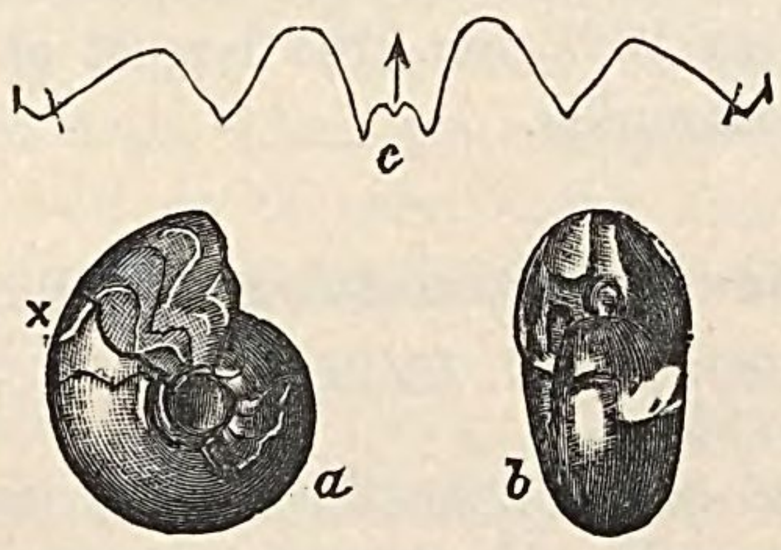
64753. Four examples, ranging in diameter from 7 to 15 mm.
Purchased, 1868.

Glyphioceras platylobum (J. Phillips).

[Fig. 86 *a*, *b*, *c*.]

1836. *Goniatites platylobus*, J. Phillips, Geol. Yorks. pt. ii. p. 235, pl. xx. ff. 5, 6.
1843. *Goniatites platylobus*, J. Morris, Cat. Brit. Foss. p. 180.
1848. *Goniatites platylobus*, H. G. Bronn, Gesch. d. Natur, vol. iii. p. 543.
1850. *Aganides platylobus* (pars), A. d'Orbigny, Prod. de Paléont. stratigr. vol. i. p. 115.
1852. *Ammonites platylobus* (pars), C. G. Giebel, Fauna der Vorwelt, vol. iii. p. 470.
1854. *Goniatites platylobus* (pars), J. Morris, Cat. Brit. Foss. 2nd ed. p. 304.
? 1880. *Goniatites platylobus*, L. G. de Koninck, Faune Calc. Carb. de la Belgique (Ann. Mus. Roy. d'Hist. nat. de Belgique, sér. Paléont. vol. v.), pt. ii. p. 103, pl. xlvii. f. 11; pl. l. ff. 11, 12.
1884. *Glyphioceras platylobum*, A. Hyatt, Proc. Boston Soc. Nat. Hist. vol. xxii. p. 329.
1888. *Goniatites platylobus* (pars), R. Etheridge, Brit. Foss. vol. i. Palæozoic, p. 312.
[*Not* 1854. *Goniatites platylobus*, F. A. Roemer, Palaeontogr. vol. iii. p. 94, pl. xiii. f. 32=*Glyphioceras Roemeri*, Holzapfel.]

Fig. 86.



Glyphioceras platylobum.—*a*, lateral view; *b*, front view, the terminal portion of the whorl restored in outline; *c*, the suture-line marked × in *a*. Drawn from a specimen in the British Museum Collection: *a* and *b* are of the natural size, *c* is enlarged twice.

Sp. Char. Shell rather small, subglobose, involute, umbilicated; greatest thickness near the umbilical margin, about nine-sixteenths of the diameter of the shell; height of outer whorl one-half of the diameter of the shell. Whorls (? number); inclusion nearly complete; umbilicus narrow, about three-sixteenths of the diameter of the shell, rather deep, with steep sides and subangular margin. Whorl subelliptical in section, a little wider than high; periphery rather broadly rounded; sides convex, their inner portion sloping inwards slightly; inner area narrow, well defined, almost perpendicular to the plane of symmetry. Body-chamber (? length). Chambers rather deep; suture-line as in fig. 86 *c*. Test ornamented with numerous, fine, close-set striæ, which are nearly direct on the lateral area and form a deep broad sinus on the periphery. Internal casts with rather coarse, obscure crenulations around the umbilicus, particularly in young shells, and with three or four nearly straight constrictions.

In his explanation of the plates, Phillips indicates that the figured specimen was in the Gilbertson Collection; but this collection, now in the British Museum, does not contain any specimen that can be identified as Phillips's type, or an example even of Phillips's species. The general collection, however, contains a few examples of the species, and upon these the preceding description has been based.

Size. Shell attaining a diameter of more than 20 mm.

Form. & Loc. Carboniferous Limestone: Todmorden, Yorkshire; Wetton, Staffordshire.

C. 4398. Three internal casts, ranging in diameter from 11 to 15 mm., probably belonging to this species; Wetton, Staffordshire. *Purchased*, 1892.

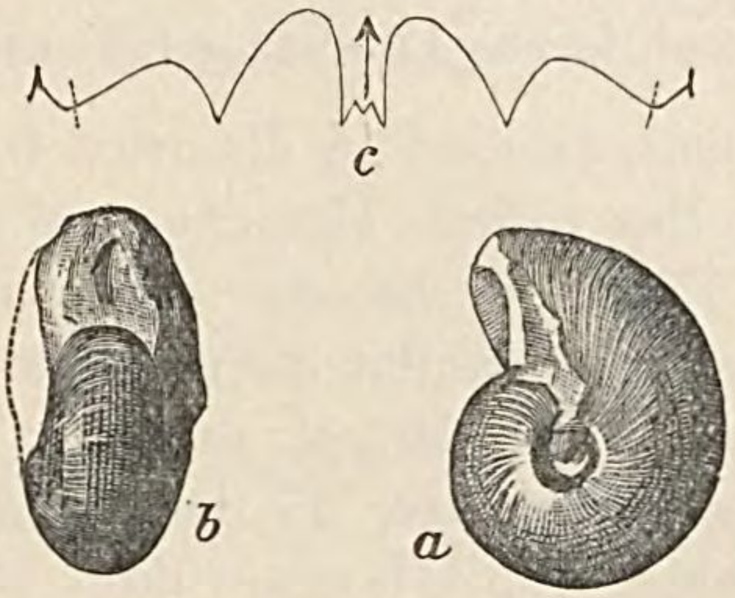
C. 5384. Three fairly well-preserved entirely septate examples, showing the characters of the species, ranging in diameter from 8·5 to 16·5 mm., the largest of which is figured above; Todmorden. *History unknown.*

Glyphioceras stenolobum (J. Phillips).

1836. *Goniatites stenolobus*, J. Phillips, Geol. Yorks. pt. ii. p. 235, pl. xx. ff. 7, 8 (? 9).
1843. *Goniatites stenolobus*, J. Morris, Cat. Brit. Foss. p. 180.
1848. *Goniatites stenolobus*, H. G. Bronn, Gesch. d. Natur, vol. iii. p. 545.
1850. *Aganides platylobus* (pars), A. d'Orbigny, Prod. de Paléont. stratigr. vol. i. p. 115.

1852. *Ammonites platylobus* (pars), C. G. Giebel, Fauna der Vorwelt, vol. iii. p. 470.
1854. *Goniatites platylobus* (pars), J. Morris, Cat. Brit. Foss. 2nd ed. p. 304.
1884. *Glyphioceras stenolobum*, A. Hyatt, Proc. Boston Soc. Nat. Hist. vol. xxii. p. 329.
1888. *Goniatites platylobus* (pars), R. Etheridge, Brit. Foss. vol. i. Palæozoic, p. 312.

Fig. 87.



Glyphioceras stenolobum.—*a*, lateral view of natural internal cast, showing the transverse and longitudinal striæ; *b*, front view of same; *c*, suture-line of another example. Drawn from specimens in the British Museum: *a*, *b* are of the natural size; *c* is enlarged twice.

Sp. Char. Shell rather small, subglobose, involute, umbilicated; greatest thickness at the umbilical margin, about five-eighths of the diameter of the shell; height of outer whorl about one-half of the diameter of the shell. Whorls (? number); inclusion nearly complete; umbilicus rather small, about one-sixth of the diameter of the shell in width, rather deep, with sloping sides and angular margin. Whorl obtusely cordate in section, wider than high; indented to nearly one-half of its height by the preceding whorl; periphery broadly convex; sides convex; inner area narrow, flattened, well-defined, sloping towards the umbilicus. Body-chamber occupying at least a whorl. Chambers not very shallow; suture-line as in fig. 87 *c*. Test thin, ornamented in the adult with fine transverse striæ, which are nearly straight on the sides and form a wide sinus on the periphery; these are crossed by obscure longitudinal striæ; in young shells the transverse striæ are relatively much coarser.

In his explanation of the plates, Phillips indicates that the figured specimen was in the Gilbertson Collection, but no specimen in this collection, now in the British Museum, agrees with Phillips's figures. The above description has been drawn up from the three larger (of the four) specimens now in the Gilbertson Collection, which have been referred, and probably correctly, to this species.

Many authors have united this with the preceding species, but if the specimens in the Collection have been correctly identified, the two species are quite distinct. *G. stenolobum* differs from *G. platylobum* in being relatively more inflated, in having its greatest thickness at the umbilical margin, in the fineness and closeness of its ornamentation, and in the form of the peripheral lobe of the suture-line. The latter as here given differs somewhat from that given by Phillips for this species.

Size. Shell attaining a diameter of 17 mm.

Form. & Loc. Carboniferous Limestone: Yorkshire.

C. 263. Four specimens, ranging in diameter from 13 to 17 mm., exhibiting the various characters of the species. One specimen, 15 mm. in diameter, shows the suture-line, and is broken so as to exhibit the coarse ornamentation of the young shell. The largest example has the following dimensions:—Diameter, 17 mm.; thickness, 11 mm.; height of outer whorl, 8 mm.; ditto above the preceding whorl, about 5 mm.; width of umbilicus, 3 mm. Locality not recorded. *Gilbertson Coll.*

C. 279 d–f. Three examples, ranging in diameter from 8 to 11·5 mm.; Ribble River. *Gilbertson Coll.*

C. 282 a–c. Three specimens, each about 10 mm. in diameter; locality not recorded. *Gilbertson Coll.*

Glyphioceras nitidum (J. Phillips).

1836. *Goniatites nitidus*, J. Phillips, Geol. Yorks. pt. ii. p. 235, pl. xx. ff. 10–12.
?1841. *Goniatites Smithii*, T. Brown, Trans. Manchester Geol. Soc. vol. i. p. 218, pl. vii. ff. 34, 35.
1843. *Goniatites nitidus*, Morris, Cat. Brit. Foss. p. 180.
1848. *Goniatites nitidus*, H. G. Bronn, Gesch. d. Natur, vol. iii. p. 543.
1850. *Aganides nitidus*, A. d'Orbigny, Prod. de Paléont. stratigr. vol. i. p. 114.
1852. *Ammonites nitidus*, C. G. Giebel, Fauna der Vorwelt, vol. iii. p. 470.
1854. *Goniatites nitidus*, J. Morris, Cat. Brit. Fos. 2nd ed. p. 304.
1884. *Glyphioceras nitidum*, A. Hyatt, Proc. Boston Soc. Nat. Hist. vol. xxii. p. 329.
1888. *Goniatites nitidus*, R. Etheridge, Brit. Foss., vol. i. Palæozoic, p. 312.

Sp. Char. Shell rather small, subglobose, inflated, umbilicated; greatest thickness at the margin of the umbilicus, about two-thirds of the diameter of the shell; height of outer whorl about three-

fifths of the diameter of the shell. Whorls (? number); inclusion nearly complete; umbilicus rather deep, nearly one-fourth of the diameter in width, with sloping sides and subangular margin. Whorl semilunate in section, wider than high; indented to rather more than one-third of its height by the preceding whorl; periphery rather broadly convex; sides convex, a little flattened near the umbilical margin; inner area narrow, flattened, sloping towards the umbilicus, sharply defined. Body-chamber occupying at least a complete whorl; aperture simple, entire, apparently without any sinuses. Chambers rather shallow; suture-line as in fig. 88. Test

Fig. 88.

Suture-line of *Glyphioceras nitidum*. Drawn from a specimen (No. C. 5382) in the British Museum, and enlarged three times.

rather thick, ornamented with somewhat coarse striæ, which often bifurcate at or near the umbilical margin and in passing over the whorl do not form either a lateral or a peripheral sinus; with about three narrow constrictions per whorl concurrent with the lines of growth; the inner area smooth.

Size. Shell attaining a diameter of about 13 mm.

Form. & Loc. Carboniferous Limestone: Yorkshire.

We have followed Prof. Hyatt in referring this species to the genus *Glyphioceras*, but we note that the species exhibits affinities to the genus *Pericyclus*.

C. 269. Small block, containing several specimens; locality not recorded. *Gilbertson Coll.*

C. 279 a–c. Three specimens, ranging in diameter from 8 to 13 mm., two of them (marked *a* and *b* respectively) being the types figured by Phillips (*op. cit.* pl. xx. ff. 10, 11); Ribble River. *Gilbertson Coll.*

C. 282 f. One example, 12 mm. in diameter, with finer ornaments and less angular umbilical margin than the types; locality not recorded. *Gilbertson Coll.*

C. 5292, C. 5299. Eight examples, ranging in diameter from 2 to 10 mm.; Halifax (Carboniferous). *Purchased*, 1895.

C. 5377. A fairly well-preserved specimen, 11 mm. in diameter; locality not recorded. *History unknown.*

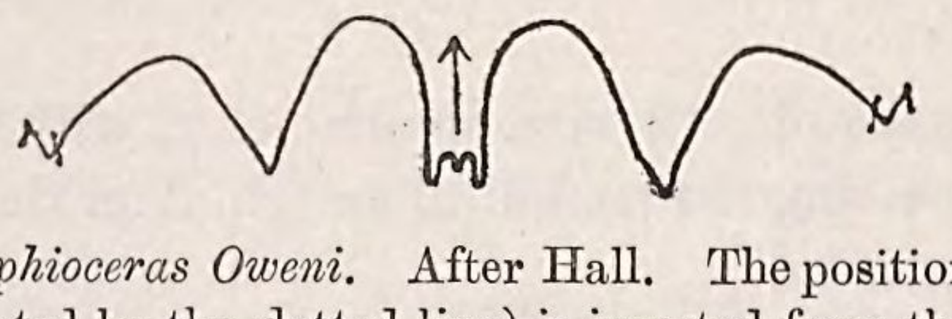
C. 5382. Two imperfect specimens, 7 and 11·5 mm. in diameter respectively, the smaller exhibiting the suture-line, and the larger the inner whorls with the suture-line; Todmorden. *History unknown.*

Glyphioceras Oweni (J. Hall).

1860. *Goniatites Oweni*, J. Hall, Thirteenth Rep. N. York State Cab. Nat. Hist. p. 100, ff. 11, 12.
1876. *Goniatites Oweni*, J. Hall, Nat. Hist. N. York, Illustr. Devon. Foss., Cephalopoda, pl. lxxiii. ff. 3–8.
1879. *Goniatites Oweni*, J. Hall, Nat. Hist. N. York, Pt. vi. Palæont., vol. v. pt. ii. p. 470, pl. lxxiii. ff. 3–8, pl. lxxiv. f. 9.
1884. *Munsteroceras Oweni*, A. Hyatt, Proc. Boston Soc. Nat. Hist. vol. xxii. p. 326.
1886. *Goniatites Oweni*, J. Hall, Geol. Surv. N. York, Fifth Ann. Rep. State Geologist, pl. (cxxviii.) 13, ff. 4–7.
1888. *Goniatites Oweni*, J. Hall, Nat. Hist. N. York, Pt. vi. Palæont., vol. v. pt. ii. Suppl. p. 40, pl. cxxviii. ff. 4–7.
1889. *Glyphioceras Oweni*, E. Holzapfel, Palæont. Abhandl., Dames & Kayser, vol. v. 1, p. 24.
1895. *Glyphioceras Oweni*, K. A. v. Zittel, Grundzüge d. Palaeont. p. 399.

Sp. Char. Shell discoidal, compressed, umbilicated; greatest thickness at a short distance from the umbilical margin, two-fifths of the diameter of the shell; height of outer whorl about two-fifths of the diameter of the shell. Whorls six to eight or nine; inclusion three-fourths; umbilicus moderately large (varying in different individuals), exposing the edges of the inner whorls. Whorl semi-elliptical in section, as high as wide, indented to one-half of its height by the preceding whorl; periphery broad, convex; sides flattened near the inner margin and gradually curving to the periphery; inner area perpendicular to the plane of symmetry. Body-chamber (? length). Chambers shallow, measured on the

Fig. 89.



Suture-line of *Glyphioceras Oweni*. After Hall. The position of the umbilical margin (indicated by the dotted line) is inserted from the specimen in the British Museum Collection.

middle of the lateral area about one-fourth of the corresponding ventro-dorsal diameter in depth; suture-line as in fig. 89. Test ·5 mm. thick, its surface marked by fine transverse striæ.

Size. Shell attaining a diameter of about 100 mm.

Form. & Loc. Goniatite Limestone, Kinderhook Group (Lower Carboniferous): Indiana, United States.

63981. Polished sagittal section of an entirely septate specimen, 28 mm. in diameter. *Purchased*, 1868.

Glyphioceras parallelum (J. Hall).

1860. *Goniatites Oweni*, var. *parallela*, J. Hall, Thirteenth Rep. N. York State Cab. Nat. Hist. p. 101, ff. 13, 14.

1876. *Goniatites Oweni*, var. *parallela*, J. Hall, Nat. Hist. N. York, Illustr. Devon. Foss., Cephalopoda, pl. lxxiii. ff. 1, 2.

1879. *Goniatites Oweni*, var. *parallela*, J. Hall, Nat. Hist. N. York, Pt. vi. Palæont., vol. v. pt. ii. p. 473, pl. lxxiii. ff. 1, 2, pl. lxxiv. f. 10.

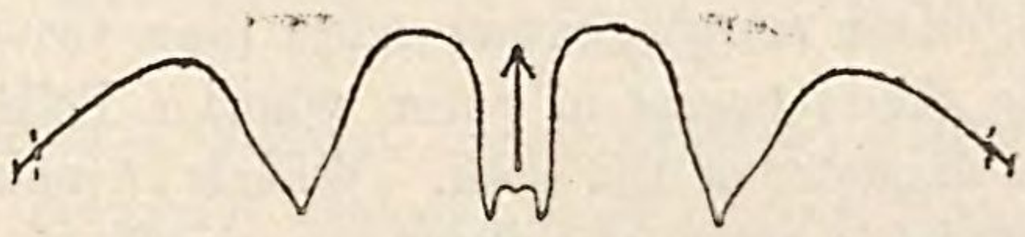
1884. *Munsteroceras parallelum*, A. Hyatt, Proc. Boston Soc. Nat. Hist. vol. xxii. p. 326.

1889. *Glyphioceras parallelum*, E. Holzapfel, Palæont. Abhandl., Dames & Kayser, vol. v. 1, p. 24.

1890. *Muensteroceras parallelum*, G. Steinmann & L. Döderlein, Elem. d. Paläont. pt. ii. p. 393.

Sp. Char. Form and general proportions not very different from *Glyph. Oweni.* The umbilicus is, however, smaller, the inclusion greater, the septa are closer, and the whorls which are sometimes less rotund are crossed at somewhat regular intervals by curved shallow constrictions, about three to a whorl. Suture-line as in fig. 90. "The sides of the dorsal [siphonal] lobe are quite parallel and the extremities reach beyond the arch of the saddle in the next posterior septum. This gives an apparent continuity to the septa, and the ventrum [periphery] is thus impressed with two parallel continuous grooves limiting the margins of the ventral [siphonal] lobes."

Fig. 90.



Suture-line of *Glyphioceras parallelum.* After Hall. The position of the umbilical margin (indicated by the dotted line) is inserted from a specimen in the British Museum Collection.

Size. The largest specimen in the Collection is 60 mm. in diameter.

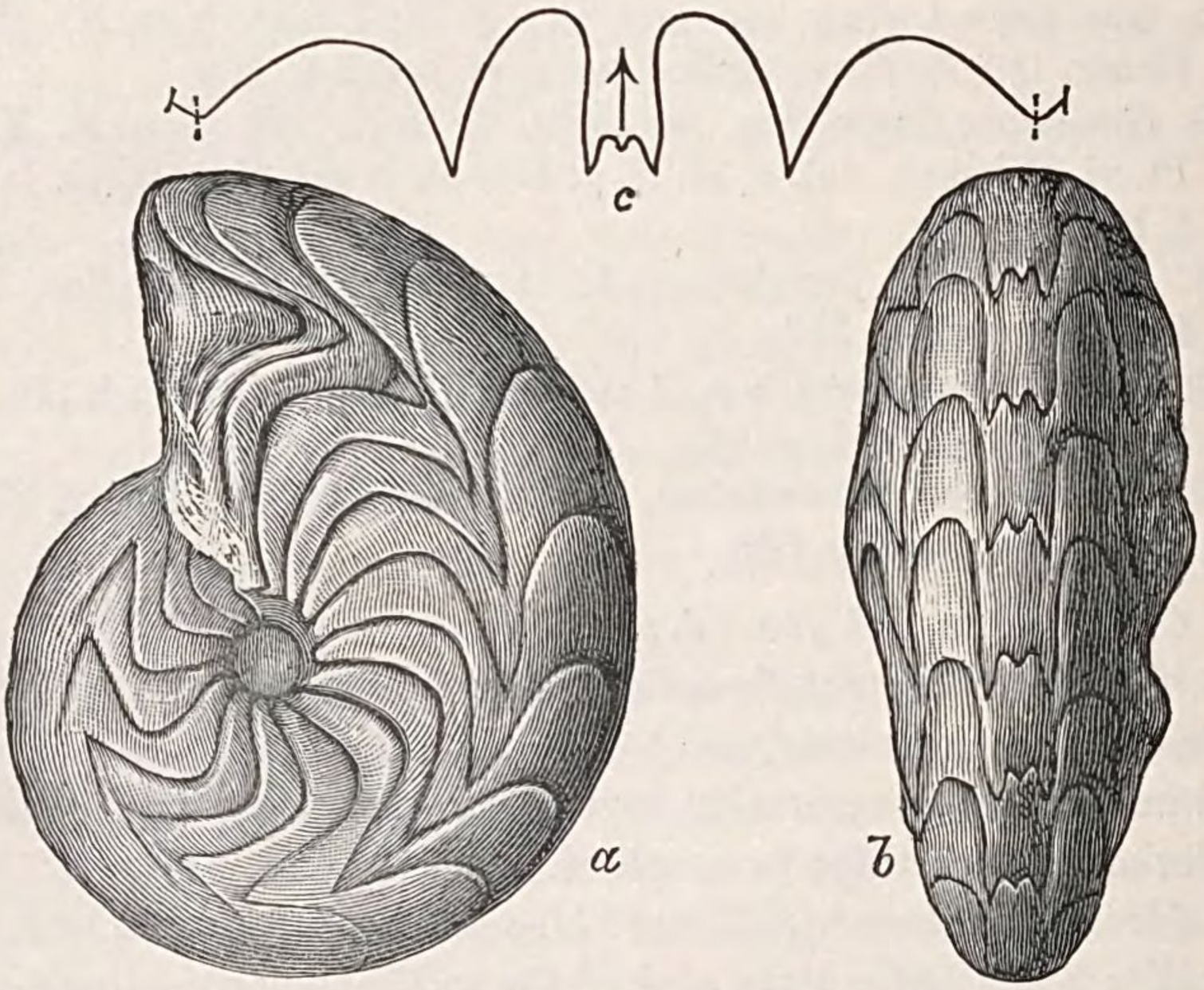
Form. & Loc. Goniatite Limestone, Kinderhook Group (Lower Carboniferous): Indiana, United States.

63982. One example, 47 mm. in diameter, showing the two parallel continuous grooves on the periphery; Indiana. *Purchased*, 1868.

C. 95. Two entirely septate specimens, each 60 mm. in diameter; Rockford, Indiana. *Purchased*, 1880.

Glyphioceras hispanicum, sp. nov.

Fig. 91.



Glyphioceras hispanicum.—*a*, lateral view; *b*, peripheral view; *c*, suture-line. Drawn of the natural size from a specimen (No. 37492) in the British Museum Collection.

Sp. Char. Shell (cast) discoidal, flattened, involute, umbilicated, sometimes with several constrictions; greatest thickness almost close to the umbilical margin, rather more than two-fifths of the diameter of the shell; height of outer whorl a little more than one-half of the diameter of the shell. Whorls (? number); inclusion almost complete; umbilicus about one-eighth of the diameter of the shell in width, exposing the edges of the inner whorls, with subangular margin. Whorl oval in section, higher than wide; indented to about one-third of its height by the preceding whorl; periphery narrowly convex, slightly flattened; sides flattened, feebly convex; inner area narrow, well-defined, nearly perpendicular to the plane of symmetry. Body-chamber (? length); chambers shallow, seventeen or eighteen in the last whorl of the

septate portion; suture-line as in fig. 91 *c*. Test not seen. Constrictions slightly waved on the lateral area and forming a sinus on the periphery.

This species may possibly be identical with *Gly. inconstans* (de Koninck) [1], but its suture-line has a larger median saddle than de Koninck represents, and the cast exhibits no traces of ornament.

The prominence of the umbilical region and the form of the lateral lobe distinguish this species from *Gly. truncatum*.

Size. Shell attaining a diameter of more than 53 mm.

Form. & Loc. Carboniferous: Asturias, Spain.

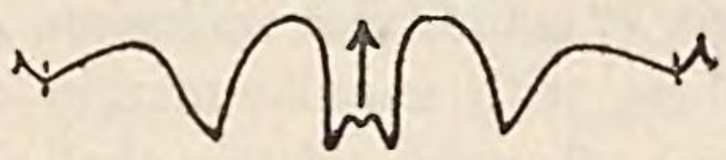
37492. Two fairly well-preserved completely septate examples, 53 and 32 mm. in diameter respectively. The larger specimen represented in fig. 91 has the following dimensions:—Diameter, 53 mm.; greatest thickness, 22 mm.; width of umbilicus, 6·5 mm.; height of outer whorl, 27·5 mm.; ditto above preceding whorl, 19 mm.

Obtained from S. P. Pratt, Esq., 1858.

Glyphioceras sp.

Sp. Char. Shell (cast) discoidal, compressed, umbilicated; greatest thickness close to the umbilical margin, about three-sevenths of the diameter of the shell; height of outer whorl about one-half of the diameter of the shell. Whorls (? number); inclusion almost complete; umbilicus a little more than one-fourth of the diameter of the shell in width, with angular margin, steep sides, exposing the edges of the inner whorls. Whorl semielliptical in section, higher

Fig. 92.



Suture-line of *Glyphioceras* sp. Drawn from the specimen in the British Museum Collection.

than wide; indented to about one-third of its height by the preceding whorl; periphery convex; sides convex, flattened near the umbilical margin; inner area narrow, well-defined, nearly perpendicular to the plane of symmetry. Body-chamber (? length). Chambers shallow, about eighteen in a whorl; suture-line as in

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[1] Faune Calc. Carb. de la Belgique (Ann. Mus. Roy. d'Hist. nat. de Belgique, sér. Paléont., vol. v.) pt. ii. 1882, p. 120, pl. xlviii. ff. 4–9. *Not* of J. Phillips, Pal. Foss. Cornwall, Devon and West Somerset (Mem. Geol. Surv.), p. 123, pl. li. f. 238.

fig. 92. Test not seen. Internal cast with about four constrictions, which are slightly waved on the lateral area and form on the periphery a sinus that is concave forwards.

This species is at once distinguished from *Gly. hispanicum* by the size of its umbilicus; it may be identical with *Gon. Malladæ*, Barrois, although its suture-line differs somewhat from that given by Barrois of his species.

Size. The only specimen in the Collection has a diameter of 41 mm.

Form. & Loc. Carboniferous: Asturias, Spain.

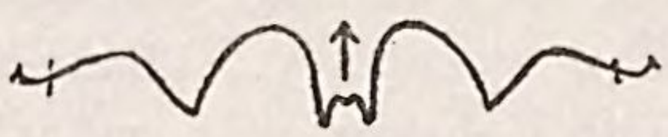
37493. A completely septate example, having the following dimensions:—Diameter, 41 mm.; height of outer whorl, 20; ditto above preceding whorl, about 13; greatest thickness, 18; width of umbilicus, 11. Its suture-line is figured above (fig. 92). *Obtained from S. P. Pratt, Esq.*, 1858.

Glyphioceras bilingue (J. Salter).

1864. *Goniatites bilinguis*, J. W. Salter, Geol. Country around Oldham (Mem. Geol. Surv.), p. 60, ff. 14 *a*, *b*, *c*.
1885. *Goniatites bilinguis*, R. Etheridge in Geol. Rhyl, Abergele, and Colwyn (Mem. Geol. Surv.), p. 17.
1888. *Goniatites bilinguis*, R. Etheridge, Brit. Foss., vol. i. Palæozoic, p. 311.
1896. *Goniatites bilinguis*, H. Bolton, Trans. Manchester Micros. Soc. 1895, pp. 130, 134.

Sp. Char. Shell compressed, involute; greatest thickness at the edge of the umbilicus, rather more than four-ninths of the diameter of the shell; height of outer whorl nearly one-half of the diameter of the shell. Whorls (? number); inclusion almost complete; umbilicus infundibuliform, with angular margin and sloping sides, nearly one-fourth of the diameter of the shell in width. Whorl bluntly sagittate in section, a little higher than wide; indented to about two-fifths of its height by the preceding whorl; periphery convex, a little flattened; sides feebly convex, with a double spiral

Fig. 93.



Suture-line of *Glyphioceras bilingue*. Drawn of the natural size from the smaller of the two specimens in the British Museum Collection (No. C. 5288).

furrow near the periphery, their portion internal to the furrow flattened; inner area distinctly marked off, narrow, sloping towards

the umbilicus. Body-chamber occupying a complete whorl; aperture with a projecting tongue-like lobe on either side near the periphery, and a deep broad hyponomic sinus. Chambers rather shallow; suture-line as in fig. 93. Test thin, its surface delicately reticulate; transverse striæ very finely crenulate, strongly arched forward at the double concentric groove and forming a deep broad sinus on the periphery; longitudinal striæ very feeble.

All the examples of this species in the Jermyn Street Museum are either very much crushed or are merely impressions on the surface of pieces of shale occurring in the Millstone Grit. No specimen can there be found so well preserved as represented in Salter's figure, and we have not seen the suture-line in any of these examples. There are two forms: one with a rather open umbilicus exposing the edges of the inner whorls, on which, as well as on the inner edge of the outer whorl, the fine ornaments of the tests are accompanied by small folds; the other with a much finer ornamentation, and a smaller and infundibuliform umbilicus. The specimens in the National Collection agree with the latter.

Size. Shell attaining a diameter of 56 mm.

Form. & Loc. Carboniferous: Halifax, Yorkshire.

C. 5288. Two fairly well-preserved examples, 46 and 56 mm. in diameter respectively, the smaller exhibiting the suture-line and the ornaments of the test, the larger (an internal cast) showing the course of the suture-line, and having attached to it a small specimen about 13 mm. in diameter, probably referable to this same species.

Purchased, 1895.

Glyphioceras reticulatum (J. Phillips).

1836. *Goniatites reticulatus*, J. Phillips, Geol. Yorks. pt. ii. p. 235, pl. xix. ff. 26–32.

1836. *Goniatites Gibsoni*, J. Phillips, ibid. pt. ii. p. 236, pl. xx. ff. 13–18.

1841. *Goniatites jugosus*, T. Brown, Trans. Manchester Geol. Soc. vol. i. p. 215, pl. vii. ff. 14, 15.

1843. *Goniatites Gibsoni, jugosus, reticulatus*, J. Morris, Cat. Brit. Foss. pp. 179, 180.

1844. *Goniatites Gibsoni, reticulatus*, F. M'Coy, Synop. Carb. Foss. Ireland, pp. 13, 15.

1848. *Goniatites reticulatus*, J. H. Cumming, Isle of Man, p. 357.

1848. *Goniatites Gibsoni, jugosus, reticulatus*, H. G. Bronn, Gesch. d. Natur, vol. iii. pp. 542, 544.

1850. *Aganides diadema* (pars), A. d'Orbigny, Prod. de Paléont. stratigr. vol. i. p. 116.

1852. *Ammonites reticulatus* (pars), C. G. Giebel, Fauna der Vorwelt, vol. iii. p. 471.
1854. *Goniatites Gibsoni, jugosus, reticulatus*, J. Morris, Cat. Brit. Foss. 2nd ed. pp. 303–4.
1855. *Aganides reticulatus*, F. M'Coy, Brit. Pal. Foss. p. 566.
? 1855–57. *Goniatites Gibsoni, reticulatus*, J. Kelly, Journ. Geol. Soc., Dublin, vol. vii. p. 7.
1860. *Goniatites crenistria*, W. H. Baily, Expl. Sheet 142 Geol. Surv. Ireland, pp. 11, 12, ff. 2 *a–h, j, l, m* (? *i, k*).
1862. *Goniatites Gibsoni, reticulatus*, J. W. Salter, Geol. Country around Bolton-le-Moors (Mem. Geol. Surv.), pp. 34, 35.
1864. *Goniatites Gibsoni, reticulatus*, J. W. Salter, Geol. Country around Oldham (Mem. Geol. Surv.), p. 59.
1876. *Goniatites Gibsoni, reticulatus*, J. Armstrong, J. Young, & D. Robertson, Cat. West. Scottish Fossils, p. 58.
1884. *Munsteroceras reticulatum*, A. Hyatt, Proc. Boston Soc. Nat. Hist. vol. xxii. p. 326.
1888. *Goniatites Gibsoni, jugosus, reticulatus*, R. Etheridge, Brit. Foss., vol. i. Palæozoic, pp. 311, 312.
1888. *Gastrioceras Gibsoni*, M. Tzwetaev, Mém. Com. géol. St. Pétersbourg, vol. v. no. 3, p. 1.
1893. *Goniatites jugosus*, H. Bolton, Cat. Types & Figured Specimens Manchester Mus. p. 15.
[*Not* 1854. *Goniatites reticulatus*, F. A. Roemer, Palæontogr. vol. iii. pl. xiii. f. 31.]

Sp. Char. Shell discoidal, somewhat inflated, with four or five angulated constrictions on the outer whorl; greatest thickness at the edge of the umbilicus, nearly one-half of the diameter of the shell; height of outer whorl a little more than one-half of the diameter of the shell. Whorls six or seven; inclusion almost complete; umbilicus about one-fourth of the diameter of the shell in width, with angular margin and sloping sides. Whorl obtusely

Fig. 94.

Suture-line of *Glyphioceras reticulatum*. Drawn from the last suture-line of a specimen in the British Museum Collection (No. 51394). Enlarged twice.

sagittate in section, rather higher than wide; indented to a little more than one-half of its height by the preceding whorl; periphery subangular; sides feebly convex, with an obtuse spiral ridge near their centre; inner area rather narrow, well-defined, flattened, sloping towards the umbilicus. Body-chamber occupying a complete whorl. Chambers rather shallow; suture-line as in fig. 94.

Test thin, delicately reticulate; the transverse striæ very finely crenulate, strongly arched forward near the periphery, and forming on the periphery a deep broad sinus; its inner surface with angulated thickenings, producing constrictions on the internal cast. Initial-chamber small, transversely ovoid.

Immature forms differ from the adult in being less inflated and in having a more convex periphery. The constrictions are scarcely visible on the test, but are well-marked on the internal cast. By breaking back and by sectioning adult examples, we have been able to satisfy ourselves that the young stages are what have been named *Gon. Gibsoni*; these not uncommonly have a slightly sulcated periphery (more conspicuous in an internal cast) and have been described as *Gon. jugosus*.

Size. Shell attaining a diameter of about 45 mm.

Form. & Loc. Carboniferous: Yorkshire and the Hartz.

26308. Three specimens, 10, 14, and 15·5 mm. in diameter respectively; Hebden Bridge, Yorkshire. *Purchased*, 1851.

51392, 51394. Two examples, 13 and 26 mm. in diameter respectively; Bolland, Yorkshire. *Purchased*, 1867.

97357. Specimen, 20 mm. in diameter; locality not recorded.
Presented on behalf of the late Mr. John Rofe, 1878.

C. 261. Eight examples, ranging in diameter from 10 to 26·5 mm.; the younger portion of the outer whorl has (in the cast) a groove in the middle of the peripheral area; High Green Wood, Yorkshire. *Gilbertson Coll.*

C. 1850. Small slab with impression of specimen at least 52 mm. in diameter; Lautenthal, Hartz (Lower Carboniferous).
Presented by John Edward Lee, Esq., 1885.

C. 5097 a. Example 16 mm. in diameter; locality unrecorded.
History unknown.

C. 5281. Ten specimens, ranging in diameter from 8 to 18 mm.; one broken and another sectioned in order to show the sculpture and form of the inner whorls; Halifax, Yorkshire. *Purchased*, 1895.

C. 5282. Five examples, ranging in diameter from about 20 to 35 mm., one being sectioned transversely to show the form of the inner whorls; Halifax, Yorkshire.
Purchased, 1895.

C. 5302, C. 5303, C. 5304. Eight specimens, ranging in diameter from 14 to 19·5 mm.; Vale of Todmorden, Yorkshire.
History unknown.

C. 5305. Three examples, 13, 15, and 24 mm. in diameter respectively, the largest with a well-marked groove on the lateral area near the periphery; High Green Wood, Yorkshire. *History unknown.*

C. 5313. Specimen, 13 mm. in diameter, its internal cast having a channelled periphery up to a diameter of 11 mm.; locality not recorded. *History unknown.*

C. 5383. An example 23 mm. in diameter; Vale of Todmorden.
History unknown.

The following are immature forms, such as have been described as *G. Gibsoni* and *G. jugosus*:—

26270. Three examples, ranging in diameter from 1·5 to 3 mm., the largest exhibiting the initial-chamber; Vale of Todmorden, Yorkshire. *Purchased*, 1851.

47661. Eight specimens, ranging in diameter from 2·75 to 4·0 mm., some showing the initial-chamber. In one example (marked *a*) the ribs are direct and pass over the peripheral area without bifurcating; it may be the young of a closely allied form; its protoconch is clearly shown. Vale of Todmorden. *Paul Mohr Coll.*

97363. Twelve examples, ranging in diameter from 2·75 to 4·75 mm., several showing the initial-chamber, and one (marked *a*) having the form to which the name *jugosus* was given; Vale of Todmorden.
Presented on behalf of the late Mr. John Rofe, 1878.

C. 278. Three specimens, each about 4·5 mm. in diameter, showing the initial-chamber; Vale of Todmorden. *Gilbertson Coll.*

C. 4958, C. 4959, C. 4960. A series of specimens, ranging in diameter from 2 to 5 mm., some showing the initial-chamber; Vale of Todmorden. *History unknown.*

C. 5291. A series of examples, ranging in diameter from 2 to 7 mm., the two largest are somewhat more involute and more inflated than the rest, and may possibly belong to another but closely allied species; Halifax. *Purchased*, 1895.

The following specimens are intermediate between this species and the following (*Gly. Davisi*); they appear to agree with the example which Phillips has figured as the adult of *Gon. reticulatus*. The immature examples in the Collection differ, however, from the specimen represented in Phillips's fig. 26 in having more inflated whorls, a wider umbilicus, and an angular periphery at a diameter of about 33 mm.

C. 5283. Six examples, ranging in diameter from 11·5 to 20·5 mm.; Halifax. *Purchased*, 1895.

C. 5285. A well-preserved internal cast, bearing fragments of the test, and having the following dimensions:—Diameter, 43 mm.; greatest thickness (at umbilical margin), 21·5 mm.; width of umbilicus (edge to edge), 13 mm.; height of outer whorl, 21 mm.; ditto above preceding whorl, 13 mm. Its periphery is angular, and there is a subangular ridge, or rather double ridge, on each lateral area. The suture-line is seen at the earlier part of the outer whorl. Halifax. *Purchased*, 1895.

C. 5286. A fairly well-preserved specimen showing the ornaments of the test, and the periphery becoming acute in the last sixth of the outer whorl. Its dimensions are:—Diameter, 35 mm.; greatest thickness (at umbilical margin), 16 mm.; width of umbilicus (edge to edge), 8 mm.; height of outer whorl, 16 mm.; ditto above preceding whorl, 5 mm. Halifax. *Purchased*, 1895.

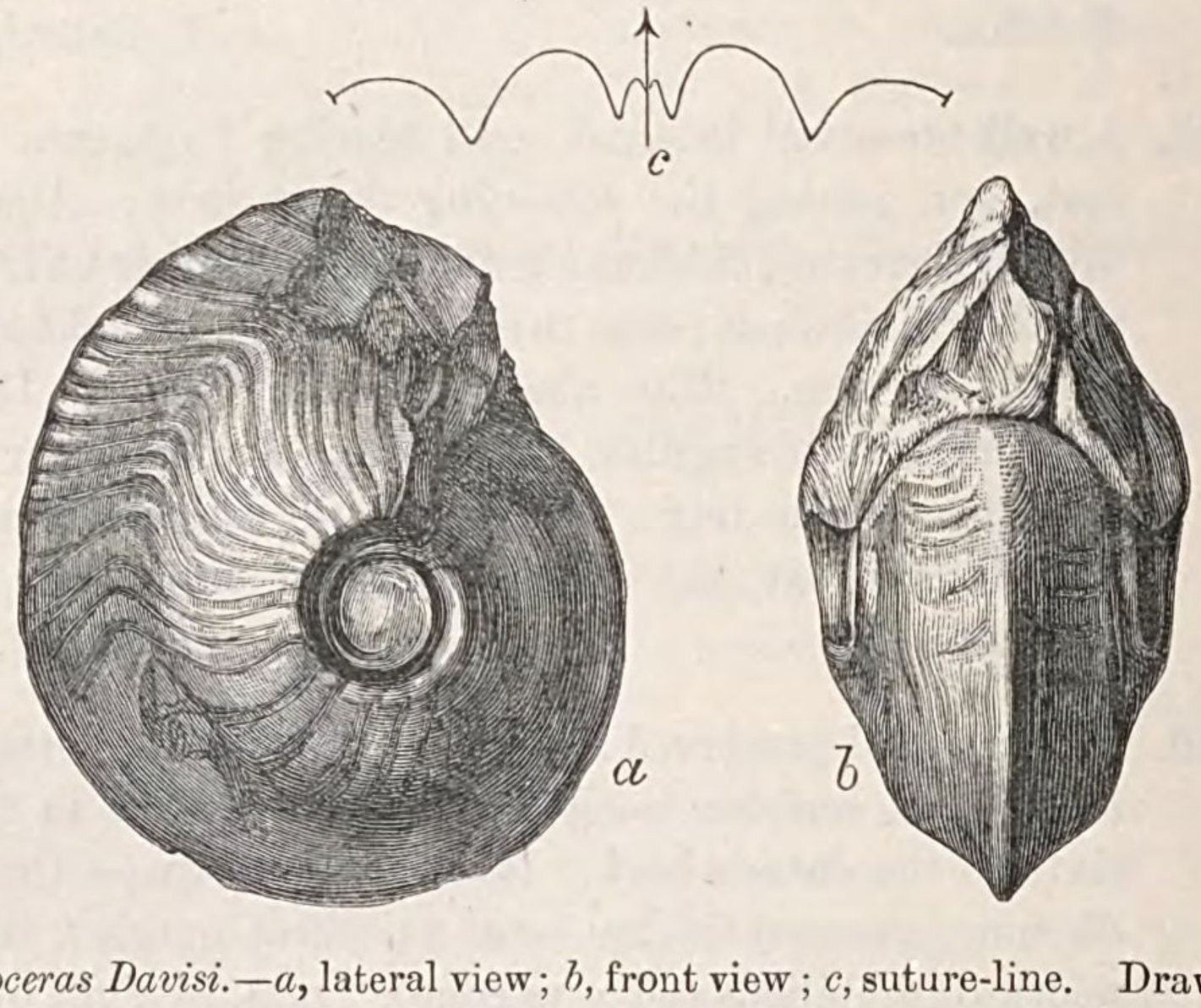
C. 5287. Much-crushed fragment (internal cast) of an example at least 58 mm. in diameter, possibly the adult of this intermediate form. The longitudinal striæ have almost disappeared, and the transverse become at the anterior part of the specimen rather widely-spaced imbricating lines. The back is quite angular, but not pinched in on either side as in *Gly. Davisi*. Halifax. *Purchased*, 1895.

C. 5290. A closely allied form, with a somewhat wider umbilicus, and without any appearance of a keel, although it has a diameter of 32 mm. Its other dimensions are:—greatest thickness, 16·5 mm.; width of umbilicus (edge to edge), 10 mm.; height of outer whorl, 12 mm.; ditto above preceding whorl, 8 mm. Halifax. *Purchased*, 1895.

Glyphioceras Davisi, sp. nov.

Sp. Char. Shell inflated, apparently without constrictions; greatest thickness at the edge of the umbilicus, one-half of the diameter of the shell; height of outer whorl about three-sevenths of the diameter of the shell. Whorls six or seven; inclusion almost complete; umbilicus about one-fourth of the diameter of the shell

Fig. 95.



Glyphioceras Davisi.—*a*, lateral view; *b*, front view; *c*, suture-line. Drawn from the type-specimen in the British Museum Collection. *a* & *b* are three-fourths of the natural size; *c* is of the natural size.

in width, with steep sides, and prominent subangular margin, exposing the edges of the inner whorls. Whorl sagittate in section, not quite so high as broad; indented to about one-third of its height by the preceding whorl; periphery acute; sides undulated, their central portion with a strong subangular ridge; inner area well-defined, rather narrow, almost at right angles to the plane of symmetry. Body-chamber occupying a complete whorl. Chambers rather shallow; suture-line as in fig. 95 *c*. Test thin, delicately crenulato-striate; the longitudinal striæ comparatively feeble, the transverse striæ delicately crenulate, strongly arched forward near the periphery, and forming on the periphery a deep V-shaped sinus.

In the immature shell the umbilicus is relatively wider, the section of whorl much higher than wide, and the periphery broadly convex.

It differs from *Gly. reticulatum* by its inflated form, its acutely

angular periphery, its undulated sides, and its prominent umbilical margin.

The two examples in the Collection were from the collection of the late Mr. J. W. Davis, of Halifax, after whom we have named the species.

Size. Shell attaining a diameter of about 60 mm.

Form. & Loc. Carboniferous: Halifax, Yorkshire.

C. 5284. Two well-preserved specimens, 60 and 44 mm. in diameter respectively, the larger showing the general form of the shell, the smaller bearing fragments of the test. The larger specimen exhibits the septa at the commencement of the outer whorl, they are very close together, and the specimen is probably an adult. Its dimensions are:— Diameter, 60 mm.; greatest thickness, 30 mm.; height of outer whorl, 27 mm.; ditto above preceding whorl, 20 mm.; width of umbilicus, 15 mm. Also a fragment, about 30 mm. in diameter, which has been cut transversely in order to show the form of the inner whorls; these are semilunate in section up to a diameter of about 18 mm., then increasing in height more rapidly than in width, their periphery becomes less broadly convex and their umbilical margin angular and prominent.

Purchased, 1895.

Glyphioceras excavatum (J. Phillips).

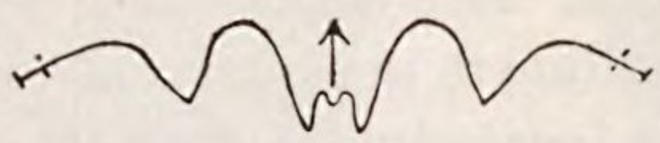
1836. *Goniatites excavatus*, J. Phillips, Geol. Yorks. pt. ii. p. 235, pl. xix. ff. 33-35.
1843. *Goniatites excavatus* (pars), J. Morris, Cat. Brit. Foss. p. 179.
1844. *Goniatites excavatus*, F. M'Coy, Synop. Carb. Foss. Ireland, p. 13.
1848. *Goniatites excavatus*, H. G. Bronn, Gesch. d. Natur, vol. iii. p. 541.
1850. *Aganides diadema* (pars), A. d'Orbigny, Prod. de Paléont. stratigr. vol. i. p. 116.
1852. *Ammonites reticulatus* (pars), C. G. Giebel, Fauna der Vorwelt, vol. iii. p. 471.
1854. *Goniatites excavatus* (pars), J. Morris, Cat. Brit. Foss. 2nd ed. p. 303.
1855–7. *Goniatites excavatus*, J. Kelly, Journ. Geol. Soc. Dublin, vol. vii. p. 7.
1880. *Goniatites excavatus*, W. Branco, Palæontogr. vol. xxvii. pl. iv. f. iii. *a–e*.
1884. *Munsteroceras excavatum*, A. Hyatt, Proc. Boston Soc. Nat. Hist. vol. xxii. p. 326.

1888. *Goniatites excavatus*, R. Etheridge, Brit. Foss., vol. i. Palæozoic, p. 311.

[*Not* 1841. *Goniatites excavatus*, J. Phillips, Pal. Foss. Cornwall, Devon & West Somerset (Mem. Geol. Surv.), p. 121, pl. l. f. 232.]

Sp. Char. Shell discoidal, compressed, involute, umbilicated; greatest thickness at the umbilical margin, about three-sevenths of the diameter of the shell; height of outer whorl nearly one-half of the diameter of the shell. Whorls (? number); inclusion nearly complete; umbilicus rather deep, about two-ninths of the diameter of the shell in width, infundibuliform, with angular margin. Whorl truncated-oval in section, a little higher than wide, indented to about one-third of its height by the preceding whorl; periphery narrowly convex, feebly carinate in the adult; sides flattened; inner area narrow, sharply defined, sloping towards the umbilicus. Body-chamber occupying fully a whorl. Chambers rather shallow, fifteen or sixteen to a whorl; suture-line as in fig. 96. Test

Fig. 96.



Suture-line of *Glyphioceras excavatum*. Traced from a specimen (C. 251) in the Gilbertson Collection, British Museum; and enlarged twice.

nearly smooth, with very delicate lines of growth, which are waved on the lateral area, and on the periphery form a wide deep backwardly-directed sinus; these are crossed by several obscure spiral lines. Each whorl with four constrictions concurrent with the lines of growth; they are deepest on the lateral area and do not intersect the umbilical margin. 'Wrinkle-layer' composed of very delicate reticulate rugæ. Initial-chamber ellipsoidal, transversely elongate.

Size. Shell attaining a diameter of 23 mm.

Form. & Loc. Carboniferous Limestone: Yorkshire.

C. 251. Six examples, ranging in diameter from 12 to 23 mm., the largest (marked *a*) being Phillips's type-specimen; one of the others, a completely septate specimen, exhibits the 'wrinkle-layer.' Bowes. *Gilbertson Coll.*

C. 5389. An imperfect specimen, 31 mm. in diameter, more inflated than the type, but probably referable to this species; Bolland. *History unknown.*

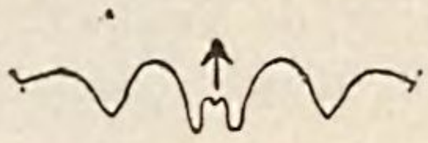
C. 5391. An example, 8 mm. in diameter, possibly referable to this species; Settle. *History unknown.*

Glyphioceras bidorsale (J. Phillips).

1836. *Goniatites bidorsalis*, J. Phillips, Geol. Yorks. pt. ii. p. 235, pl. xx. ff. 2–4.
1843. *Goniatites bidorsalis*, J. Morris, Cat. Brit. Foss. p. 179.
1848. *Goniatites bidorsalis*, H. G. Bronn, Gesch. d. Natur, vol. iii. p. 540.
1850. *Aganides bidorsalis*, A. d'Orbigny, Prod. de Paléont. stratigr. vol. i. p. 115.
1852. *Ammonites bidorsalis*, C. G. Giebel, Fauna der Vorwelt, vol. iii. p. 478.
1854. *Goniatites bidorsalis*, J. Morris, Cat. Brit. Foss. 2nd ed. p. 303.
1888. *Goniatites bidorsalis*, R. Etheridge, Brit. Foss., vol. i. Palæozoic, p. 311.

Sp. Char. Shell rather small, subglobose, umbilicated; greatest thickness at the margin of the umbilicus, a little more than one-half of the diameter of the shell; height of outer whorl a little less than one-half of the diameter of the shell. Whorls (? number); inclusion almost complete; umbilicus about two-ninths of the diameter of the shell in width, with rather steep sides and a subangular margin. Whorl oval in section, a little wider than high; indented to about one-fourth of its height by the preceding whorl; periphery narrowly convex, feebly truncate; sides slightly convex; inner area narrow, convex, not very sharply defined. Body-chamber (? length). Chambers rather shallow, about sixteen or seventeen to a whorl; suture-line as in fig. 97. Test not very thin, ornamented with fine raised lines which bend forward near the periphery, and on the latter form a deep, broad, backwardly-directed sinus; these are crossed by fine spiral lines, which are especially conspicuous at the margins of the peripheral area.

Fig. 97.



Suture-line of *Glyphioceras bidorsale*. Traced from a specimen in the Gilbertson Collection, British Museum; and enlarged twice.

We think it highly probable that future observations will show that the form here described is merely the immature condition of a species belonging to the *reticulatus*-group. Phillips describes the "dorsal lobe" [*i. e.*, the median saddle] as "double, *each part divided*," but each half, when well-preserved, appears to us to be fairly acute and without any sign of division.

Size. The largest specimen in the Collection is entirely septate,

and 11 mm. in diameter, so that the species probably attained a diameter of at least 15 mm.

Form. & Loc. Carboniferous Shale: Woodfold, Yorkshire.

C. 272. A split nodule containing several examples probably belonging to this species. *Gilbertson Coll.*

Form. Carboniferous. Locality not recorded.

C. 277. Six specimens, ranging in diameter from 7·5 to 11 mm., exhibiting the various characters of the species. Some examples show the suture-line very clearly. *Gilbertson Coll.*

Form. & Loc. Carboniferous Shale: Woodfold, Yorkshire.

Glyphioceras diadema (H. E. Beyrich).

1832. *Ammonites diadema* (Gold.), A. H. Dumont, Mém. const. géol. Liége, p. 356 [*nom. nud.*].

? 1836. *Goniatites striolatus*, J. Phillips, Geol. Yorks. pt. ii. p. 234, pl. xix. ff. 14–18.

1837. *Ammonites diadema* (Goldf.), H. E. Beyrich, De Goniatitis in montibus rhenanis occurrentibus, p. 15, pl. ii. ff. 8, 9, 10.

1837. *Ammonites Listeri*, H. E. Beyrich, ibid. p. 14, pl. ii. ff. 6 *a*, *b* & f. 11.

1837. *Ammonites diadema* (Goldf.), E. Beyrich, Beitr. zur Kenntn. Verstein. rhein. Uebergangsgeb. p. 41, pl. ii. ff. 8, 9, 10.

1837. *Ammonites Listeri*, E. Beyrich, ibid. p. 39, pl. ii. ff. 6 *a*, *b* & f. 11.

1842–44. *Ammonites diadema*, L. G. de Koninck, Descr. Anim. Foss. p. 574, pl. l. ff. 1 *a–f*, 2 *a*, *b*.

1843. *Goniatites diadema*, L. G. de Koninck in J. J. d'Omalius d'Halloy, Précis elem. géol. p. 515.

1843. *Goniatites Beyrichianus*, L. G. de Koninck, ibid. p. 515.

? 1843. *Goniatites striolatus*, J. Morris, Cat. Brit. Foss. p. 180.

? 1844. *Goniatites striolatus*, F. M'Coy, Synop. Carb. Foss. Ireland, p. 16.

1845. *Goniatites diadema*, E. de Verneuil, in Murchison, de Verneuil, & de Keyserling, Géol. Russie d'Europe, vol. ii. p. 367, pl. xxvii. ff. 1 *a–d*.

? 1848. *Goniatites striolatus*, J. H. Cumming, Isle of Man, p. 357.

1848. *Goniatites diadema*, H. G. Bronn, Gesch. d. Natur, vol. iii. p. 541.

1850. *Aganides diadema*, A. d'Orbigny, Prod. de Paléont. stratigr. vol. i. p. 116.

? 1850. *Aganides striolatus*, A. d'Orbigny, ibid. p. 115.

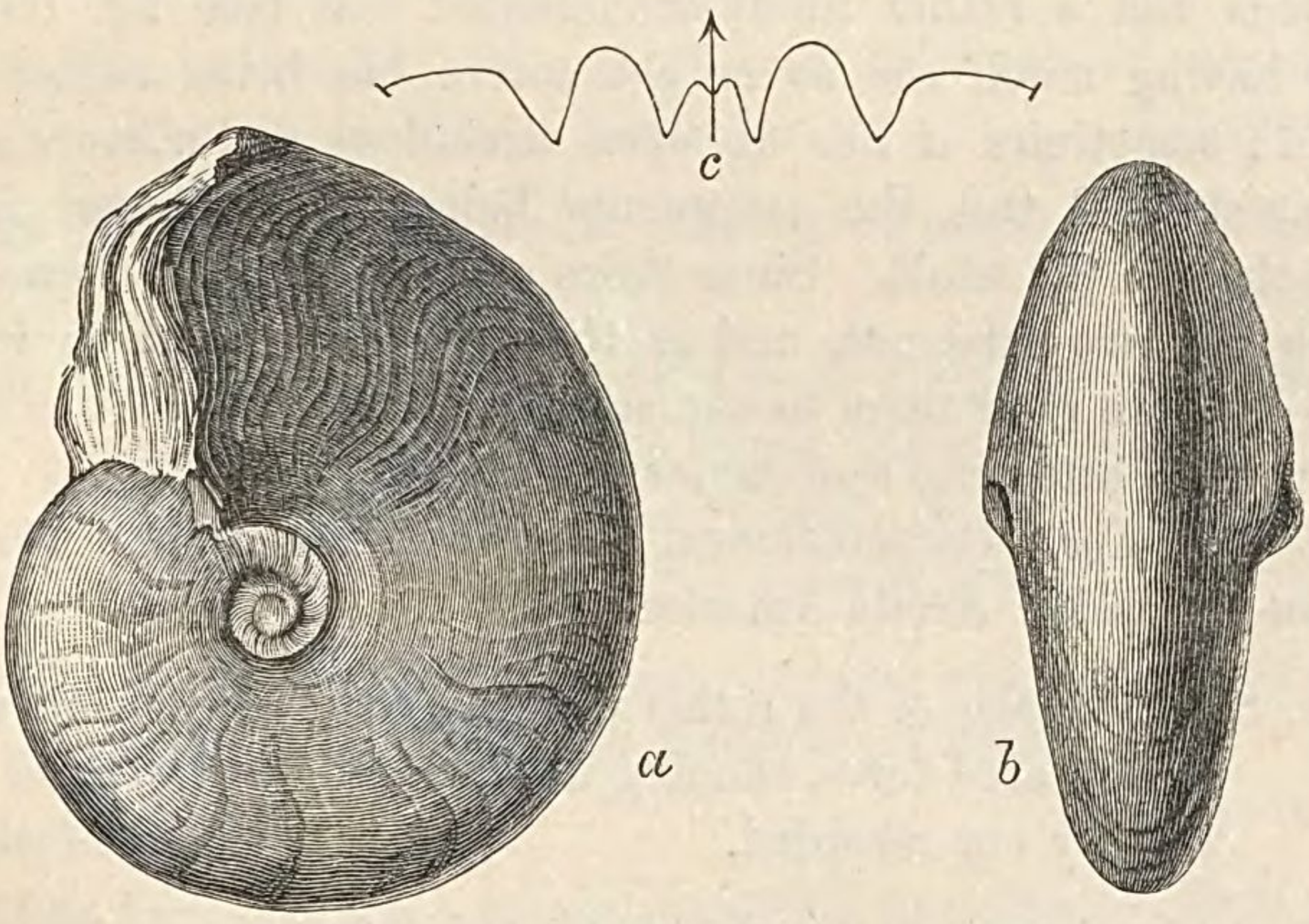
1851. *Goniatites diadema*, G. Sandberger, Jahrb. Nassau Ver. Nat. pt. vii. (ii. & iii.), p. 304, pl. iii. f. 33.

1852. *Ammonites Listeri* (pars), C. G. Giebel, Fauna der Vorwelt, vol. iii. p. 475.

1854. *Goniatites diadema*, J. Morris, Cat. Brit. Foss. 2nd ed. p. 303.

? 1854. *Goniatites striolatus*, J. Morris, ibid. p. 304.
1855. *Aganides diadema*, F. M'Coy, Brit. Pal. Foss. p. 563.
? 1855–57. *Goniatites striolatus*, J. Kelly, Journ. Geol. Soc. Dublin, vol. vii. p. 7.
? 1863. *Goniatites diadema*, F. Roemer, Zeitschr. deutsch. geol. Gesell. vol. xv. p. 578, pl. xv. ff. 1 *a*, *b*, *c*.
1863. *Goniatites Listeri*, F. Roemer, ibid. vol. xv. p. 580, pl. xv. ff. 2 *a*, *b*.
1880. *Goniatites diadema*, W. Branco, Palæontogr. vol. xxvii. pl. iv. f. 1.
1884. *Glyphioceras diadema*, A. Hyatt, Proc. Boston Soc. Nat. Hist. vol. xxii. p. 329.
1884. "*Ammonites diadema*, L. v. Buch," E. Beyrich, Zeitschr. deutsch. geol. Gesell. vol. xxxvi. pp. 213–215.
1888. *Goniatites diadema*, R. Etheridge, Brit. Foss., vol. i. Palæozoic, p. 311.
? 1888. *Goniatites striolatus*, R. Etheridge, ibid. p. 313.
1889. *Gastrioceras diadema*, E. Holzapfel, Palæont. Abhandl., Dames & Kayser, vol. v. 1, p. 26.
1890. *Glyphioceras diadema*, G. Steinmann & L. Döderlein, Elem. d. Paläont. pt. ii. p. 393.
1895. *Glyphioceras diadema*, K. A. v. Zittel, Grundzüge d. Palaeont. p. 399.

Fig. 98.



Glyphioceras diadema.—*a*, lateral view; *b*, peripheral view; *c*, suture-line. *a* and *b* are drawn two-thirds of the natural size from the largest specimen in the British Museum Collection (No. 64814); *c* is drawn of the natural size from another specimen (No. 64811) in the Collection.

Sp. Char. Shell variable, discoidal, umbilicated, the young much more inflated than the adult; greatest thickness near the edge of the umbilicus, about two-fifths of the diameter of the shell; height

of outer whorl about one-half of the diameter of the shell. Whorls (? number); inclusion nearly complete; umbilicus shallow, about one-fifth of the diameter of the shell in width, the edge with a slightly raised rim in the young shell, but wanting this in the adult. Whorl almost semilunate in section in the young, elongate-oval in the adult, higher than wide (in the young the reverse of this is the case); indented to nearly one-half of its height by the preceding whorl; periphery narrowly convex; sides inflated in the young, compressed in the adult; inner area flat, sloping towards the umbilicus and thus forming an obtuse angle with the sides of the shell. Body-chamber occupying at least one whorl. Chambers very shallow, eighteen or nineteen to a whorl; suture-line as in fig. 98 *c*. Test ornamented with fine striæ, most of which bifurcate in the umbilical region in the adult shell; they are sigmoidal upon the sides of the shell and form a backwardly-directed linguiform sinus on the periphery; in very young shells the striæ are simple and their course is nearly straight. A number of shallow constrictions (from 3 to 5 per whorl) concurrent with the striæ are present, and are more conspicuous in casts. Initial-chamber ellipsoidal or spindle-shaped, transversely elongate.

This species is very variable: sometimes it has a relatively small umbilicus and a rather finely ornamented test (see fig. 98), the young having much the same characters but being rather more inflated; sometimes it has an open umbilicus and a more or less coarsely striated test, the ornaments being much coarser in the young than in the adult. Since there are intermediate forms connecting the two extremes, and as they all have the same form of suture-line, we refer them to one species.

Size. Shell attaining a diameter of 66 mm.

Form. & Loc. Carboniferous. *British*: Yorkshire. *Foreign*: Belgium; Russia; Arctic America.

47651. Six examples of the rather coarsely ornamented and widely umbilicated form, ranging in diameter from 10 to 20 mm.; locality not recorded. *Paul Mohr Coll.*

47662. A specimen of the finely striated form, about 19 mm. in diameter; Chokier, Belgium. *Paul Mohr Coll.*

51390 a. An example, 6 mm. in diameter, probably referable to this species; Vale of Todmorden. *Purchased*, 1867.

64807. A series of twenty-two examples, ranging in diameter from 9 to 34 mm., showing the young and adult stages of the two principal varieties of this species—the widely umbili-

cated and coarsely striated, as well as the narrowly umbilicated and finely striated, form; only one (which is similar to No. 64811) exhibits the suture-line; Chokier.
Purchased, 1869.

64811. The septate portion of a specimen nearly 40 mm. in diameter, displaying the suture-line (fig. 98 *c*); Chokier.
Purchased, 1869.

64814. A very fine adult example, 66 mm. in diameter, bearing fragments of the test, but not displaying the suture-line, labelled in De Koninck's handwriting "échantillon adulte le plus grand qui ait été trouvé jusqu'ici" (fig. 98 *a*, *b*); Chokier. *Purchased*, 1869.

74308. Small block full of examples of the widely umbilicated and coarsely striated variety; Chokier. *Purchased*, 1875.

97357 d. A specimen in matrix, 11·5 mm. in diameter; locality not recorded.
Presented on behalf of the late Mr. John Rofe, 1878.

C. 22. Two specimens, 24 and 26·5 mm. in diameter respectively; Schartymka, Oural, Russia. *Purchased*, 1881.

C. 265. Two examples, 13 and 14 mm. in diameter respectively; High Green Wood, Yorkshire. *Gilbertson Coll.*

C. 408. A specimen, 11 mm. in diameter, in matrix; Chokier.
Egerton Coll.

C. 474. Two examples, 18 and 26 mm. in diameter respectively, the smaller compressed, the larger more inflated and with a wider umbilicus; Berg Island, Arctic America (Nares coll.). *Transferred from Mus. Pract. Geol.*

C. 5096. Two examples, illustrating the two varieties of this species, each about 17 mm. in diameter; Chokier.
History unknown.

C. 5097. Two examples of the narrowly umbilicated form, 12 and 20 mm. in diameter respectively; locality not recorded.
History unknown.

C. 5098. Four small blocks full of examples of both forms of this species; one block containing near its edge a specimen of the widely umbilicated form showing the inner whorls and the initial-chamber; Rochdale, Yorkshire.
Transferred from Mus. Pract. Geol.

C. 5099. Two specimens, each 11·5 mm. in diameter; High Green Wood. *History unknown.*

C. 5296 a, C. 5293, C. 5299 a. Five examples, ranging in diameter from 9 to 16 mm., the last exhibiting the suture-line clearly; Halifax. *Purchased*, 1895.

C. 5375. Five specimens, ranging from 8 to 21 mm. in diameter; locality not recorded. *History unknown.*

C. 5376. Two examples of the coarsely ornamented, widely umbilicated form, 11 and 13 mm. in diameter respectively; locality not recorded. *History unknown.*

C. 5754. Two specimens, 24 and 25 mm. in diameter respectively; Russia. *History unknown.*

Glyphioceras calyx (J. Phillips).

1836. *Goniatites calyx*, J. Phillips, Geol. Yorks. pt. ii. p. 236, pl. xx. ff. 22, 23.
1836. *Goniatites mutabilis* (pars), J. Phillips, ibid. pt. ii. p. 236, pl. xx. ff. 24, 25 (*not* 26).
1843. *Goniatites calyx*, J. Morris, Cat. Brit. Foss. p. 179.
1848. *Goniatites calyx*, H. G. Bronn, Gesch. d. Natur, vol. iii. p. 541.
1850. *Aganides mutabilis*, A. d'Orbigny, Prod. de Paléont. stratigr. vol. i. p. 115.
1852. *Ammonites vesica* (pars), C. G. Giebel, Fauna der Vorwelt, vol. iii. p. 470.
1854. *Goniatites calyx*, J. Morris, Cat. Brit. Foss. 2nd ed. p. 303.
1880. *Goniatites calyx*, L. G. de Koninck, Faune Calc. Carb. de la Belgique (Ann. Mus. Roy. d'Hist. nat. de Belgique, sér. Paléont., vol. v.), pt. ii. p. 111, pl. l. f. 18.
1884. *Homoceras calyx*, A. Hyatt, Proc. Boston Soc. Nat. Hist. vol. xxii. p. 330.
1888. *Goniatites calyx*, R. Etheridge, Brit. Foss., vol. i. Palæozoic, p. 311.

Sp. Char. Shell small, evolute, widely umbilicated; greatest thickness at the angular umbilical margin, about equal to the diameter of the shell; height of outer whorl about one-fourth of the diameter of the shell. Whorls five or six; inclusion nearly one-half; umbilicus infundibuliform, with acute margin and sloping sides, about two-thirds of the diameter of the shell in width, exposing the inner margins of the inner whorls. Whorl depressed-lunulate, almost trapezoidal in section, four times as wide as high; indented to about one-third of its height by the preceding whorl; periphery

broad, flattened, very slightly convex, continuous with the lateral area; inner area well defined, flattened, forming an acute angle with the combined peripheral and lateral areas. Length of body-chamber not seen; chambers and suture-line not seen. Test ornamented with very fine direct transverse striæ, often with minute crenulations on the acute umbilical margin. Initial-chamber small, subglobular.

Hyatt made this species the type and only representative of his genus *Homoceras*, but it is most probably the immature form of another species. Holzapfel[1] regards it as the young of *Glyph. mutabile*, or of an allied species. The largest example in the Gilbertson Collection, which may be the specimen figured by Phillips and upon which the above description has chiefly been drawn up, resembles very closely indeed examples here (p. 205) described as a widely-umbilicated form of *Gly. diadema*, particularly the example specially referred to on one of the small blocks, No. C. 5098.

Size. Shell attaining a diameter of rather more than 6 mm.

Form. & Loc. Carboniferous Limestone: Yorkshire; Belgium (Calcaire de Visé—Assise VI.).

64757. Two examples, 4·5 and 6 mm. in diameter respectively; Visé, Belgium. *Purchased*, 1868.

C. 252. Four pieces of matrix containing examples ranging in diameter from 1·5 to 6·5 mm., and a piece exhibiting a cast of the umbilicus; High Green Wood, Yorkshire. *Gilbertson Coll.*

C. 282 g. One example, 4 mm. in diameter; locality not recorded. *Gilbertson Coll.*

C. 4959 a, C. 4960 a. Two examples, 4 and 3 mm. in diameter respectively, both showing the initial-chamber, and the larger also the transverse striæ of the test; Vale of Todmorden, Yorkshire. *History unknown.*

C. 5294. Eight specimens, ranging in diameter from 2 to 4 mm., some showing the initial-chamber, the largest exhibiting also the ornaments of the test; Halifax (Carboniferous). *Purchased*, 1895.

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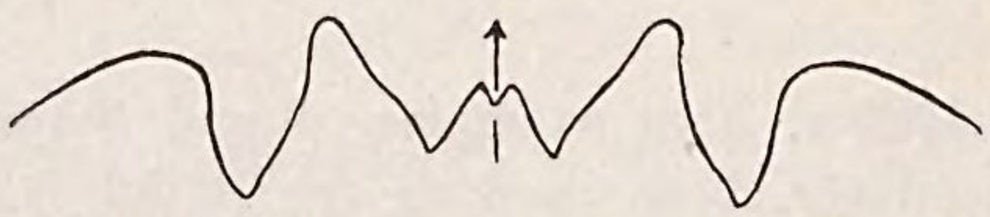
[1] E. Holzapfel, Palæont. Abhandl., Dames & Kayser, vol. v. 1, 1889, p. 30.

Glyphioceras complicatum (L. G. de Koninck).

1842–44. *Ammonites complicatus*, L. G. de Koninck, Descr. Anim. Foss. p. 567, pl. l. f. 8.
1848. *Goniatites complicatus*, H. G. Bronn, Gesch. d. Natur, vol. iii. p. 541.
1850. *Aganides complicatus*, A. d'Orbigny, Prod. de Paléont. stratigr. vol. i. p. 115.
1852. *Ammonites sphæricus* (pars), C. G. Giebel, Fauna der Vorwelt, vol. iii. p. 471.
1878. *Goniatites complicatus*, J. J. Bigsby, Thesaur. dev.-carb. p. 337.
1882. *Goniatites complicatus*, L. G. de Koninck, Faune Calc. Carb. de la Belgique (Ann. Mus. Roy. d'Hist. nat. de Belgique, sér. Paléont. vol. v.), pt. ii. p. 105, pl. l. ff. 4, 4 *a*.
1884. *Glyphioceras complicatum*, A. Hyatt, Proc. Boston Soc. Nat. Hist. vol. xxii. p. 329.

Sp. Char. Shell of medium size, discoidal, compressed; greatest thickness at a short distance from the umbilical margin, about three-sevenths of the diameter of the shell; height of outer whorl about five-eighths of the diameter of the shell. Whorls six to eight; inclusion almost complete; umbilicus small, about one-tenth of the diameter of the shell in width, with an angular margin. Whorl elongate-oval in section, higher than wide; indented to about one-half of its height by the preceding whorl; periphery narrowly convex; sides convex, slightly flattened; inner area imperfectly defined, sloping towards the umbilicus. Body-chamber (? length). Chambers shallow, about twenty-three or twenty-four to a whorl; suture-line as in fig. 99.

Fig. 99.



Suture-line of *Glyphioceras complicatum*.
After de Koninck.

Test almost smooth, or with only very fine sinuous lines of growth.

Size. Shell attaining a diameter of more than 30 mm.

Form. & Loc. Calcaire de Visé (Assise VI),=Carboniferous Limestone: Visé, Belgium.

64750. Imperfect and distorted example, 13 mm. in diameter.

Glyphioceras ? paucilobum (J. Phillips).

1836. *Goniatites paucilobus*, J. Phillips, Geol. Yorks. pt. ii. p. 236, pl. xx. ff. 36–38.
1843. *Goniatites paucilobus*, J. Morris, Cat. Brit. Foss. p. 180.
1848. *Goniatites paucilobus*, H. G. Bronn, Gesch. d. Natur, vol. iii. p. 543.
1850. *Aganides paucilobus*, A. d'Orbigny, Prod. de Paléont. stratigr. vol. i. p. 115.
1852. *Ammonites paucilobus*, C. G. Giebel, Fauna der Vorwelt, vol. iii. p. 469.
1854. *Goniatites paucilobus*, J. Morris, Cat. Brit. Foss. 2nd ed. p. 304.
1862. *Goniatites paucilobus*, J. W. Salter, Geol. country around Bolton-le-Moors (Mem. Geol. Surv.), p. 34.
1884. *Nomismoceras paucilobus*, A. Hyatt, Proc. Boston Soc. Nat. Hist. vol. xxii. p. 331.
1884. *Glyphioceras paucilobum*, K. A. Zittel, Handb. d. Palæont. vol. ii. p. 420.
1888. *Goniatites paucilobus*, R. Etheridge, Brit. Foss. vol. i., Palæozoic, p. 312.

Sp. Char. Shell discoidal, compressed, involute; greatest thickness at the umbilicus, nearly one-half of the diameter of the shell; height of outer whorl rather more than one-half of the diameter of the shell. Whorls (? number); inclusion complete; umbilicus very small, or possibly closed. Whorl semielliptical in section, a little higher than wide; considerably indented by the preceding whorl; periphery narrowly convex; sides feebly convex, flattened; no inner area. Body-chamber not seen. Chambers shallow; suture-line as in fig. 100. Test very thin, ornamented with delicate striæ, which are waved on the lateral area and form a deep and rather broad sinus on the periphery. Each whorl with at least one constriction which follows the direction of the lines of growth and is deepest at the periphery, almost disappearing near the umbilicus.

Fig. 100.

Suture-line of *Glyphioceras ? paucilobum*. Drawn from the specimen in the Gilbertson Collection, British Museum; and enlarged twice.

Size. The only specimen in the Collection has a diameter of 13 mm. and is entirely septate.

Form. & Loc. Carboniferous Limestone: Yorkshire.

C. 257. An entirely septate specimen, 13 mm. in diameter, probably Phillips's type. In his explanation of the plate, Phillips

indicates that the figured specimen is in the Gilbertson Collection. This is the only specimen in the collection referable to this species, and since it agrees fairly well with Phillips's figure, there can be scarcely any doubt as to its being the type-specimen. *Gilbertson Coll.*

Glyphioceras spirale (J. Phillips).

1841. *Goniatites spiralis*, J. Phillips, Pal. Foss. Cornwall, Devon & W. Somerset, p. 121, pl. l. f. 233.
? 1843. *Goniatites granosus*, J. E. Portlock, Rep. Geol. Londonderry, p. 407, pl. xxix A. f. 9.
1843. *Goniatites striatus*, F. A. Roemer, Verst. Harzgeb. p. 34, pl. ix. ff. 11 *a*, *b*.
1843. *Goniatites spiralis*, J. Morris, Cat. Brit. Foss. p. 180.
? 1843. *Goniatites granosus*, J. Morris, ibid. p. 179.
1844. *Goniatites spiralis*, F. M'Coy, Synop. Carb. Foss. Ireland, p. 16.
1848. *Goniatites spiralis*, H. G. Bronn, Gesch. d. Natur, vol. iii. p. 544.
1852. *Ammonites spiralis*, C. G. Giebel, Fauna der Vorwelt, vol. iii. pt. i. p. 454.
1854. *Goniatites spiralis*, J. Morris, Cat. Brit. Foss. 2nd ed. p. 304.
? 1854. *Goniatites granosus*, J. Morris, ibid. 2nd ed. p. 303.
? 1855–57. *Goniatites granosus*, J. Kelly, Journ. Geol. Soc. Dublin, vol. vii. p. 7.
1855–57. *Goniatites spiralis*, J. Kelly, ibid. vol. vii. p. 7.
1862–64. *Goniatites spiralis*, F. A. Roemer, Palæontogr. vol. ix. p. 11, pl. iv. ff. 2 *a*, *b*, *c*.
1864. *Goniatites spiralis*, J. W. Salter, Geol. Country around Oldham (Mem. Geol. Surv.), p. 59.
? 1878. *Goniatites Baylei*, A. Leymerie, Descrip. géol. et paléont. Pyrénées, p. 747, pl. C. f. 4.
1888. *Goniatites spiralis*, R. Etheridge, Brit. Foss. vol. i., Palæozoic, p. 313.
? 1888. *Goniatites granosus*, R. Etheridge, ibid. vol. i., Palæozoic, p. 311.

Sp. Char. Shell discoidal, (compressed ?); umbilicus very small; test with numerous, close, equal, spiral striæ, the interspaces being transversely striated.

Fig. 101.

Suture-line of *Glyphioceras spirale*.
After Roemer.

Nearly all the specimens which we have seen are crushed quite flat; if the example No. C. 268 is rightly identified, the thickness at a diameter of 25·5 mm. is 9·5 mm. We have seen only

indistinct traces of what appear to be septa, and these indicate the division *Glyphioceras*. We reproduce (fig. 101) Roemer's figure of the suture-line of this species.

Size. The largest specimen in the Collection has a diameter of about 70 mm.

Form. & Loc. British—Culm : Waddon Barton, near Chudleigh, Devon ; Bampton, Devon ; Hele, Devon. Carboniferous Limestone ? *Foreign*—Culm : Marburg, Nassau.

The examples of this species in the Collection were presented by John Edward Lee, Esq., 1885, unless otherwise stated.

32971. Slab bearing numerous impressions, labelled "Coddon Hill," [N. Devon], but the matrix agrees perfectly with that from Waddon Barton. *Purchased*, 1848.

C. 268. One half of a well-preserved specimen 25·5 mm. in diameter, divided transversely ; apparently from the Carboniferous Limestone, but locality not recorded. *Gilbertson Coll.*

C. 609. Sixty-five small slabs with impressions of numerous examples of this species, in some cases associated with small evolute shells probably referable to *Nomismoceras spirorbis* : Waddon Barton.

C. 1638, C. 1639. Ninety-two similar slabs ; Waddon Barton.

C. 1640. Four similar slabs ; Bampton, Devon.

C. 1642. Slab bearing impression of this species ; Marburg, Nassau.

C. 1643. Two slabs ; Hele, Devon.

C. 2040. Thirty-two small slabs with impressions of numerous examples of this species, the largest specimen nearly 70 mm. in diameter ; Waddon Barton.

C. 5058. Small slab bearing two examples ; locality not recorded (Waddon Barton ?). *Transferred from Mus. Pract. Geol.*

Glyphioceras, sp.

The following specimen doubtless belongs to this genus, but is specifically indeterminable. Its affinities are probably with the group of *G. sphæricum*.

C. 4155. A much-abraded example, 22 mm. in diameter. Carboniferous.; Mt. Pierre, near the Fitzroy River, Kimberley District, Western Australia.

Presented by the Government of Western Australia, per H. P. Woodward, Esq., 1892.

The following specimens are probably referable to the genus *Glyphioceras*:—

C. 1609. Two crushed and imperfect internal casts with an ornamentation somewhat resembling that of *G. obtusum* or *G. implicatum*; one has been broken across and ground so as to show the septa, but neither shows the suture-line. Carboniferous Limestone: Venn, Landkey, N. Devon.

Purchased, 1886.

C. 4153. A small slab, containing the section figured by A. H. Foord as *Goniatites*, sp, in Geol. Mag. [3] vol. vii. 1890, p. 102, pl. v. f. 5. Carboniferous: Mt. Pierre, near the Fitzroy River, Kimberley District, Western Australia.

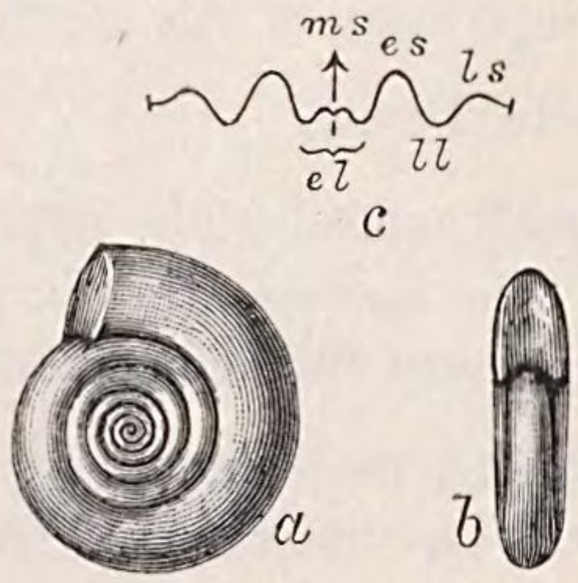
Presented by the Government of Western Australia, per H. P. Woodward, Esq., 1892.

Genus **NOMISMOCERAS,** Hyatt [1] (pars).

Syn. *Goniatites*, J. Phillips, 1836 [2] (pars), et auct.; *Ammonites*, L. G. de Koninck, 1842–44 [3] (pars), et auct.; *Aganides*, A. d'Orbigny, 1850 [4] (pars).

Type. *Goniatites spirorbis*, J. Phillips, Geol. Yorkshire, pt. ii. 1836, p. 236, pl. xx. ff. 51–55.

Fig. 102.



Nomismoceras spirorbis.—*a*, lateral view: *b*, front view: *c*, suture-line—*ms*, median saddle; *el*, external, outer or peripheral lobe; *es*, external, outer or peripheral saddle; *ll*, lateral lobe; *ls*, lateral saddle. Drawn from a specimen in the Gilbertson Collection, British Museum; *a* and *b* are one and a half times, and *c* is four times, the natural size.

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[1] Proc. Boston Soc. Nat. Hist. vol. xxii. p. 330.
[2] Geol. Yorkshire, pt. ii. pp. 236, 237.
[3] Descr. Anim. Foss. p. 582.
[4] Prod. de Paléont. stratigr. vol. i. pp. 115, 116.

Gen. Char. Shell usually small, much compressed, usually widely umbilicated, its inner whorls evolute; suture-line with rounded lobes; external (outer or peripheral) lobe wide, divided by a small median saddle; external (outer or peripheral) saddle very broad, low; lateral lobe very wide, shallow.

Carboniferous.

Hyatt included in this genus "a series of dwarfed forms with compressed whorls, open umbilici, resembling in miniature the larger forms of the *Prolecanites* but differing from these decidedly in their sutures;" and besides the discoidal, widely-umbilicated evolute forms such as *Gon. spirorbis*, Phill., and *Gon. rotiformis*, Phill., included also the more involute shells *Gon. platylobus*, Phill., and *Gon. paucilobus*, Phill., considering the latter species to be "intermediate between the discoidal forms of this genus and *Dimorphoceras*." We have, however, followed Holzapfel in restricting this genus to the very evolute forms, taking *Gon. spirorbis*, Phill., as the type; and have referred the other species to the genus *Glyphioceras*.

Nomismoceras spirorbis (J. Phillips).

1836. *Goniatites spirorbis*, J. Phillips, Geol. Yorks. pt. ii. p. 236, pl. xx. ff. 51–55.
1841. *Goniatites spirorbis*, J. Phillips, Pal. Foss. Cornwall, Devon, and West Somerset (Mem. Geol. Surv.), p. 122, pl. li. f. 236.
1843. *Goniatites spirorbis*, J. Morris, Cat. Brit. Foss. p. 180.
1848. *Goniatites spirorbis*, H. G. Bronn, Gesch. d. Natur, vol. iii. p. 544.
1850. *Aganides spirorbis*, A. d'Orbigny, Prod. de Paléont. stratigr. vol. i. p. 115.
1852. *Ammonites spirorbis*, C. G. Giebel, Fauna der Vorwelt, vol. iii. p. 410.
1854. *Goniatites spirorbis*, J. Morris, Cat. Brit. Foss. 2nd ed. p. 304.
1880. *Goniatites spirorbis*, L. G. de Koninck, Faune du Calc. Carb. de la Belgique (Ann. Mus. Roy. d'Hist. nat. de Belgique, sér. Paléont. vol. v.), pt. ii. p. 115, pl. l. f. 3.
1880. *Goniatites spirorbis*, W. Branco, Palæontogr. vol. xxvii. pl. v. ff. 5 *a–c*.
1884. *Nomismoceras spirorbis*, A. Hyatt, Proc. Boston Soc. Nat. Hist. vol. xxii. p. 331.
1888. *Goniatites spirorbis*, R. Etheridge, Brit. Foss. vol. i., Palæozoic, p. 313.
1895. *Nomismoceras spirorbis*, K. A. v. Zittel, Grundzüge d. Palæont. p. 399.
1895. *Goniatites* [*Nomismoceras*] *spirorbis*, G. C. Crick, Quart. Journ. Geol. Soc. vol. li. p. 652.

Sp. Char. Shell small, discoidal, evolute, widely umbilicated; greatest thickness at a short distance from the umbilical margin, about one-fourth of the diameter of the shell; height of outer whorl from one-third to one-fourth of the diameter of the shell. Whorls seven or eight; inclusion (in the outer whorl) nearly one-half; umbilicus shallow, about one-half of the diameter of the shell in width, exposing the inner whorls. Whorl oval in section, about as wide as high; not much indented by the preceding whorl; periphery narrowly convex; sides feebly convex, flattened, their greatest convexity being at a short distance from the umbilicus; inner area imperfectly defined, continuous with the sides, convex, sloping towards the umbilicus. Body-chamber (? length). Chambers shallow; suture-line as in fig. 102 *c*, p. 212. Test very thin, almost smooth, with very faint lines of growth and obscure transverse backwardly-directed folds near the umbilicus. Initial-chamber very small, ellipsoidal.

Size. Shell attaining a diameter of 12 mm.

Form. & Loc. Carboniferous Limestone: Bolland, Yorkshire; Visé, Belgium (Calcaire de Visé—Assise VI.). Culm: Devon.

47659. Five specimens, ranging in diameter from 3·5 to 5 mm.; locality not recorded, probably Belgium. *Paul Mohr Coll.*

64759. A series of specimens, ranging in diameter from 4 to 7 mm.; Visé, Belgium. *Purchased*, 1868.

97368. An example, 5·75 mm. in diameter, in matrix: Carboniferous Limestone; locality not recorded.
Presented on behalf of the late Mr. John Rofe, 1878.

C. 270. Two specimens, in matrix, 6·5 and 8 mm. in diameter respectively, the smaller (marked *a*) being Phillips's type. Also two specimens 4 and 5 mm. in diameter respectively, possibly belonging to another species: they are more evolute, and increase less rapidly than the type; at their greatest diameter the whorls are wider than high, and the test of the larger bears exceedingly fine transverse striæ, which are not seen in Phillips's type; neither of them exhibits the suture-line. Black Hall, Bolland.
Gilbertson Coll.

C. 273 b. A fairly well-preserved specimen, 12 mm. in diameter; Bolland. *Gilbertson Coll.*

C. 281 c. An imperfect specimen, 8 mm. in diameter, probably belonging to this species; Bolland. *Gilbertson Coll.*

C. 610, C. 2041, C. 2042. Thirty-five small slabs bearing small evolute shells, often associated with *Glyphioceras spirale* (Phillips), possibly referable to this species; Waddon Barton, near Chudleigh, S. Devon.

Presented by John Edward Lee, Esq., 1885.

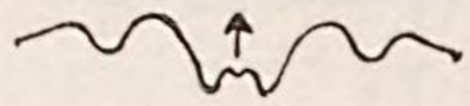
Nomismoceras rotiforme (J. Phillips).

1836. *Goniatites rotiformis*, J. Phillips, Geol. Yorks. pt. ii. p. 237, pl. xx. ff. 56–58.
1842–44. *Ammonites vittiger* (pars), L. G. de Koninck, Descr. Anim. Foss. p. 582, pl. l. ff. 5 *a–c*.
1843. *Goniatites rotiformis*, J. Morris, Cat. Brit. Foss. p. 180.
1848. *Goniatites vittiger* (pars), H. G. Bronn, Gesch. d. Natur, vol. iii. p. 546.
1850. *Aganides vittiger* (pars), A. d'Orbigny, Prod. de Paléont. stratigr. vol. i. p. 116.
1852. *Ammonites vittiger* (pars), C. G. Giebel, Fauna der Vorwelt, vol. iii. p. 467.
1854. *Goniatites rotiformis*, J. Morris, Cat. Brit. Foss. 2nd ed. p. 304.
1855–57. *Goniatites rotiformis*, J. Kelly, Journ. Geol. Soc. Dublin, vol. vii. p. 7.
1880. *Goniatites rotiformis*, L. G. de Koninck, Faune Calc. Carb. de la Belgique (Ann. Mus. Roy. d'Hist. nat. de Belgique, sér. Paléont. vol. v.), pt. ii. p. 114, pl. l. f. 16.
1884. *Nomismoceras rotiformis*, A. Hyatt, Proc. Boston Soc. Nat. Hist. vol. xxii. p. 331.
1888. *Goniatites rotiformis*, R. Etheridge, Brit. Foss. vol. i., Palæozoic, p. 312.

Sp. Char. Shell small, lenticular, much compressed, widely umbilicated; greatest thickness at about the middle of the lateral area, nearly one-fifth of the diameter of the shell; height of outer whorl a little more than one-third of the diameter of the shell. Whorls eight or nine; inclusion about one-half; umbilicus shallow, about two-fifths of the diameter of the shell in width, exposing the inner edges of all the inner whorls. Whorl subtriangular in section, much higher than wide; indented to about two-sevenths of its height by the preceding whorl; periphery flat, about two-sevenths of the corresponding height of the whorl in width, with subangular edges; sides feebly convex, flattened, with a narrow well-defined depressed area adjoining the periphero-lateral angle, and a broader, less distinctly defined depressed area near the umbilicus; inner area exceedingly narrow, imperfectly defined, sloping towards the umbilicus. Body-chamber occupying nearly an entire whorl. Chambers very shallow, suture-line as in fig. 103. Test

very thin, nearly smooth, with sigmoidal folds on the lateral area; these being strongest on the depressed area near the umbilical

Fig. 103.



Suture-line of *Nomismoceras rotiforme*. Drawn from a specimen in the Gilbertson Collection, British Museum; and enlarged four times.

margin, and dividing that area into a number of fossettes, which are very conspicuous in internal casts.

Very like *Nom. vittiger*, but with less convex whorls, a wider umbilicus, and a number of fossettes on the whorl near the umbilical margin.

Size. The largest specimen in the series is 21 mm. in diameter.

Form. & Loc. Carboniferous Limestone: Yorkshire, Derbyshire, and Belgium.

65039. An example, 8·5 mm. in diameter, and an elliptical specimen whose diameters are 16 and 20 mm. respectively. These specimens were placed with other examples labelled "Tournai." De Koninck, however, only knew the species from Visé, and probably these specimens were from that locality. *Purchased*, 1868.

C. 271. Phillips's type specimen, in matrix; and a portion of an example, in matrix, showing the suture-line. Associated with the latter is a fragment of a specimen possibly indicating a new species; only the lateral area of the whorl is displayed; its inner half is much depressed, its outer ornamented with oblique forwardly-inclined elongated nodes; the whole surface being ornamented with fine transverse incised striæ, which on the depressed portion of the whorl form a deep forwardly-concave sinus, and become wider and more deeply incised as they approach the periphery. Locality not recorded; probably Yorkshire. *Gilbertson Coll.*

C. 273 c. Two examples, each 13·5 mm. in diameter, the larger more inflated than the type; Bolland, Yorkshire. *Gilbertson Coll.*

C. 281 d. An example, 8 mm. in diameter, in matrix; Bolland. *Gilbertson Coll.*

C. 1657. Two specimens, 12 and 13 mm. in diameter respectively; Derbyshire. *Presented by J. E. Lee, Esq.*, 1885.

C. 4290. An example, 15 mm. in diameter, in matrix; and a well-preserved specimen, 21 mm. in diameter. Bolland (?). *Purchased*, 1887.

Nomismoceras vittiger (J. Phillips).

1836. *Goniatites vittiger*, J. Phillips, Geol. Yorks. pt. ii. p. 237, pl. xx. ff. 59, 60.
1842–44. *Ammonites vittiger* (pars), L. G. de Koninck, Descr. Anim. Foss. p. 582.
1843. *Goniatites vittiger*, J. Morris, Cat. Brit. Foss. p. 180.
1844. *Goniatites vittiger*, F. M'Coy, Synop. Carb. Foss. Ireland, p. 16.
1848. *Goniatites vittiger* (pars), H. G. Bronn, Gesch. d. Natur, vol. iii. p. 546.
1850. *Aganides vittiger* (pars), A. d'Orbigny, Prod. de Paléont. stratigr. vol. i. p. 116.
1852. *Ammonites vittiger* (pars), C. G. Giebel, Fauna der Vorwelt, vol. iii. p. 467.
1854. *Goniatites vittiger*, J. Morris, Cat. Brit. Foss. 2nd ed. p. 305.
1855–57. *Goniatites vittiger*, J. Kelly, Journ. Geol. Soc. Dublin, vol. vii. p. 7.
1880. *Goniatites vittiger*, L. G. de Koninck, Faune Calc. Carb. de la Belgique (Ann. Mus. Roy. d'Hist. nat. de Belgique, sér. Paléont., vol. v.), pt. ii. p. 113, pl. l. f. 17.
1880. *Goniatites vittiger*, W. Branco, Palæontogr. vol. xxvii. pl. v. f. 4.
1888. *Goniatites vittiger*, R. Etheridge, Brit. Foss. vol. i., Palæozoic, p. 313.
1895. *Nomismoceras vittatum*, K. A. v. Zittel, Grundzüge d. Palæont. p. 399.

Sp. Char. Shell small, lenticular, widely umbilicated; greatest thickness at about the middle of the lateral area, about one-fourth of the diameter of the shell; height of outer whorl rather more than three-eighths of the diameter of the shell. Whorls seven or eight; inclusion about two-thirds; umbilicus shallow, not quite three-eighths of the diameter of the shell in width, exposing the edges of all the inner whorls. Whorl sagittate in section, higher than wide; indented to two-sevenths of its height by the preceding whorl; periphery flat, about one-fourth or one-fifth of the corresponding height of the whorl in width, with subangular margins; sides feebly convex, flattened, with a narrow well-defined depressed area adjoining the periphero-lateral angle; inner area exceedingly narrow, imperfectly defined, sloping towards the umbilicus. Body-chamber occupying nearly an entire whorl. Chambers and suture-line only imperfectly seen; the latter apparently closely resembling

that of *Nomismoc. rotiforme*. Test thin, ornamented with exceedingly delicate lines of growth which form a shallow sinus on the lateral area and a rather deep sinus on the periphery. Initial-chamber ellipsoidal, transversely elongate.

Size. Phillips's type has a diameter of 17·5 mm., but the species may have attained a larger size.

Form. & Loc. Carboniferous Limestone: Yorkshire; Visé, Belgium (Calcaire de Visé—Assise VI.).

64857. An example, 6·5 mm. in diameter; Visé, Belgium.
Purchased, 1868.

97360, 97368 b. Two well-preserved examples, 20 and 22 mm. in diameter respectively; also an example 7·5 mm. in diameter, in matrix: Carboniferous Limestone; locality not recorded.
Presented on behalf of the late Mr. John Rofe, 1878.

C. 273. Two examples, each 17·5 mm. in diameter, one of them (marked *a*) being Phillips's type. Also two imperfect specimens each about 23 mm. in diameter, probably belonging to this species; they are, however, more widely umbilicated than Phillips's type, and may possibly be adult forms of his *rotiformis*. Bolland, Yorkshire.
Gilbertson Coll.

C. 5400. A well-preserved specimen, 11 mm. in diameter, in matrix, showing the inner whorls and the initial-chamber: Carboniferous Limestone; locality not recorded.
History unknown.

C. 5401. A similar example, 20 mm. in diameter; Bolland.
History unknown.

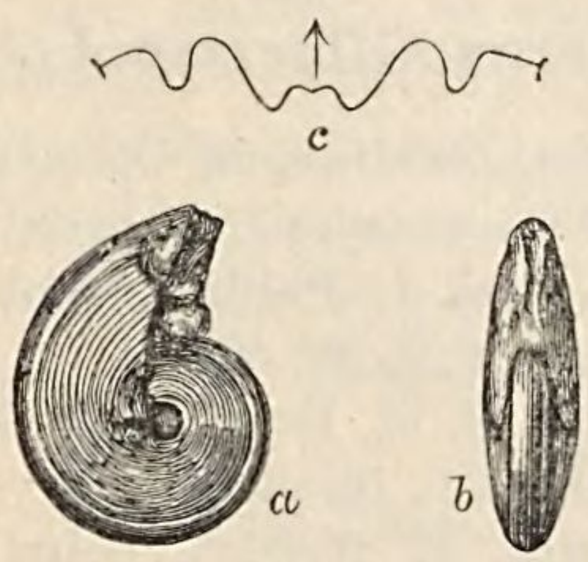
Nomismoceras ornatum, sp. nov.

? 1836. *Goniatites foraminosus*, J. Phillips, Geol. Yorks. pt. ii. p. 234.

Sp. Char. Shell discoidal, involute, much compressed; greatest thickness at the umbilical margin, about two-sevenths of the diameter of the shell; height of the outer whorl nearly two-thirds of the diameter of the shell. Whorls few (? number); inclusion almost complete; umbilicus narrow, about one-twelfth of the diameter of the shell in width, with subangular margin. Whorl sagittate in section, rather more than twice as high as wide; indented to nearly two-fifths of its height by the preceding whorl; periphery narrowly convex; sides flattened, with a deep spiral groove near the periphery; inner area well-defined, narrow, almost at right angles to the plane of symmetry, sloping very slightly towards the

umbilicus. Body-chamber occupying three-fourths of the outer whorl. Depth of chambers not seen, suture-line as in fig. 104 *c*. Test thin, ornamented with regular close-set spiral striæ, and with obscure transverse forwardly-inclined folds, which are more conspicuous in the young shell.

Fig. 104.



Nomismoceras ornatum.—*a*, lateral view; *b*, front view; *c*, suture-line. Drawn from a specimen in the British Museum. *a* & *b* are of the natural size; *c* is enlarged twice.

This is probably the *Gon. foraminosus* of Phillips, but that author's description is so incomplete, that in the absence of a figure we have not been able to identify his species, and accordingly have discarded Phillips's name.

Size. Shell attaining a diameter of 18 mm.

Form. & Loc. Carboniferous: Halifax, Yorkshire.

C. 5279. Three examples, 8, 12·5, and 18 mm. in diameter respectively. The largest is represented in fig. 104 *a*, *b*, *c*. Its other dimensions are:—Thickness, 5 mm.; width of umbilicus, 1·5 mm.; height of outer whorl, 11·5 mm.; ditto above preceding whorl, 7 mm. *Purchased*, 1895.

Genus **DIMORPHOCERAS,** Hyatt [1].

Syn. *Goniatites*, J. Phillips, 1836 [2] (pars), et auct.; *Aganides*, A. d'Orbigny, 1850 [3] (pars); *Ammonites*, C. G. Giebel, 1852 [4] (pars).

Type. *Goniatites Gilbertsoni*, J. Phillips, Geol. Yorkshire, pt. ii. 1836, p. 236, pl. xx. ff. 27–31.

Gen. Char. Shell lenticular, involute, or minutely umbilicated; whorls compressed, their greatest thickness at the umbilicus,

[1] Proc. Boston Soc. Nat. Hist. vol. xxii. p. 331 (1884).
[2] Geol. Yorkshire, pt. ii. p. 236.
[3] Prod. de Paléont. stratigr. vol. i. p. 114.
[4] Fauna der Vorwelt, vol. iii. pp. 467, 483.

periphery narrowly rounded. External (outer or peripheral) lobe divided by a median saddle, and each half again divided by a minute saddle; external (outer or peripheral) saddle narrow, rounded; lateral lobe deep, narrow, sometimes divided by a small saddle; lateral saddle undivided, broad.

Carboniferous.

Dimorphoceras Gilbertsoni (J. Phillips).

1832. *Ammonites atratus*, Goldfuss, in Dechen's translation of De la Beche's Handb. of Geognosy, p. 537 [*nom. nud.*].

1836. *Goniatites Gilbertsoni*, J. Phillips, Geol. Yorks. pt. ii. p. 236, pl. xx. ff. 27, 28 & 31 (? ff. 29, 30).

1837. *Ammonites atratus*, H. E. Beyrich, De Goniatitis in montibus, rhenanis occurrentibus, p. 16, pl. ii. f. 7.

1837. *Ammonites atratus*, E. Beyrich, Beitr. geol. Kenntn. Uebergangsgeb. p. 42, pl. ii. f. 7.

1839. *Goniatites atratus*, G. Münster, Beitr. zur Petrefact. i. p. 37, pl. iii. ff. 8 *a*, *b* (*not* 8 *c*).

1843. *Goniatites atratus*, G. Münster, Beitr. zur Petrefact. i. 2nd ed. p. 59, pl. iii. ff. 8 *a*, *b* (*not* 8 *c*).

1843. *Goniatites Gilbertsoni*, J. Morris, Cat. Brit. Foss. p. 179.

1842–44. *Goniatites atratus*, L. G. de Koninck, Descr. Anim. Foss. p. 581, pl. l. ff. 3 *a*, *b*, *c*.

1848. *Goniatites Gilbertsoni*, H. G. Bronn, Gesch. d. Natur, vol. iii. p. 542.

1849. *Goniatites Gilbertsoni*, T. Brown, Foss. Conch. p. 28, pl. xxi. ff. 4, 5.

? 1849. *Goniatites discors*, T. Brown, ibid. p. 28, pl. xxi. ff. 18, 18*.

1850. *Aganides Gilbertsoni, atratus*, A. d'Orbigny, Prod. de Paléont. stratigr. pp. 114, 116.

1852. *Ammonites atratus* (pars), C. G. Giebel, Fauna der Vorwelt, vol. iii. p. 462.

1852. *Ammonites Gilbertsoni*, C. G. Giebel, ibid. vol. iii. pt. i. p. 483.

1854. *Goniatites Gilbertsoni*, J. Morris, Cat. Brit. Foss. 2nd ed. p. 303.

1855–57. *Goniatites Gilbertsoni*, J. Kelly, Journ. Geol. Soc. Dublin, vol. vii. p. 7.

1880. *Goniatites atratus*, W. Branco, Palæontogr. vol. xxvii. p. 31, pl. iv. f. ii *a–l*.

1884. *Dimorphoceras Gilbertsoni*, A. Hyatt, Proc. Boston Soc. Nat. Hist. vol. xxii. p. 331.

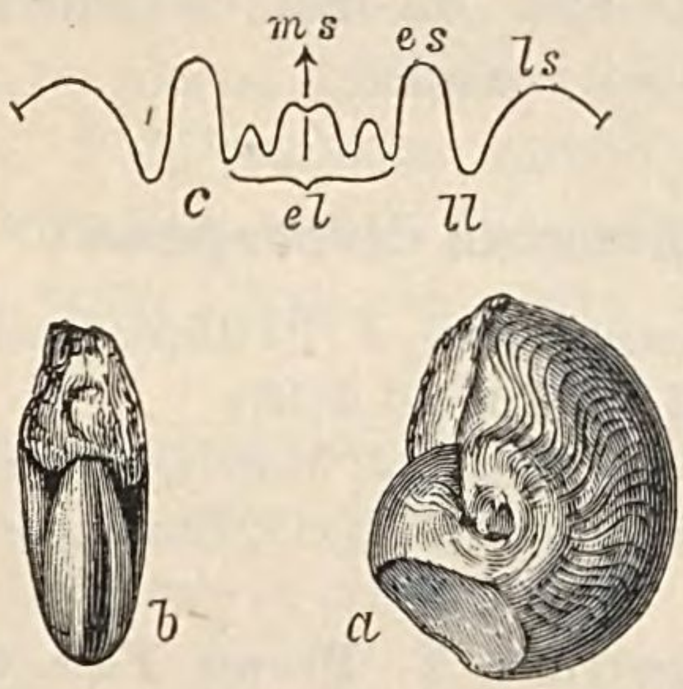
1884. *Dimorphoceras Gilbertsoni*, K. A. Zittel, Handb. d. Palæont. vol. ii. p. 420.

1888. *Gonatites Gilbertsoni, atratus*, R. Etheridge, Brit. Foss. vol. i., Palæozoic, p. 311.

? 1889. *Dimorphoceras Gilbertsoni*, E. Holzapfel, Palæont. Abhandl. Dames & Kayser, vol. v. 1, p. 38, pl. iii. f. 12.
1896. *Goniatites atratus*, H. Bolton, Trans. Manchester Micros. Soc. 1895, pp. 130, 134.

Sp. Char. Shell rather small, rapidly increasing, much compressed, involute; greatest thickness near the edge of the umbilicus, about one-third of the diameter of the shell; height of outer whorl nearly two-thirds of the diameter of the shell. Whorls few, (? number); inclusion complete; umbilicus exceedingly small, almost closed. Whorl obtusely sagittate in section, nearly twice as high as wide; indented to a little more than one-third of its height by the preceding whorl; periphery narrowly convex; sides much flattened, feebly convex; no inner area. Body-chamber occupying the last

Fig. 105.



Dimorphoceras Gilbertsoni.—*a*, lateral view: *b*, front view: *c*, suture-line—*ms*, median saddle; *el*, external, outer or peripheral lobe; *es*, external, outer or peripheral saddle; *ll*, lateral lobe; *ls*, lateral saddle. *a* is drawn from Phillips's type specimen in the Gilbertson Collection, British Museum; *b* & *c* from other specimens in the same collection. *a* & *b* are drawn of the natural size; *c* is enlarged twice.

whorl; aperture with a deep lateral sinus and a deep peripheral sinus. Chambers very shallow; suture-line as in fig. 105 *c*. Test thin, ornamented with delicate transverse striæ; these are convex forwards on the inner fourth of the whorl, concave forwards on the middle half, and at the outer fourth turn abruptly backwards and form a deep linguiform sinus on the periphery. Initial-chamber spindle-shaped, transversely elongate.

Size. Shell attaining a diameter of rather more than 20 mm.

Form. & Loc. Carboniferous: Yorkshire; Belgium.

41599. A series of specimens, some in a piece of matrix, ranging in diameter from 4 to 6 mm.; Halifax. *Purchased*, 1865.

51390. Two examples, 6·5 and 7·5 mm. in diameter; Vale of Todmorden. *Purchased*, 1867.

51394 a. Two somewhat imperfect examples, 10 and 20 mm. in diameter respectively; Bolland. *Purchased*, 1867.

64809. Six specimens, ranging in diameter from 6 to 18 mm., labelled "*Goniatites atratus*"; Chokier, Belgium. *Purchased*, 1868.

C. 249. Seven specimens, exhibiting the various characters of the species, ranging in diameter from 8·5 to 20·5 mm., the largest being the specimen figured by Phillips (*op. cit.* pl. xx. f. 27); Carboniferous, but locality not recorded. *Gilbertson Coll.*

C. 5398. An example, rather more inflated than the type, 16 mm. in diameter and 7·5 mm. in thickness; Carboniferous, but locality not recorded. *History unknown.*

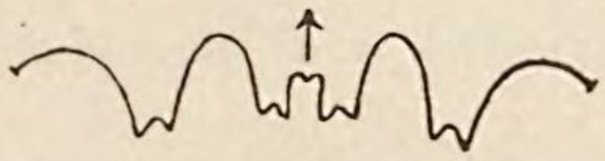
Dimorphoceras discrepans (T. Brown).

1836. *Goniatites Looneyi* (pars), J. Phillips, Geol. Yorks. pt. ii. p. 236, pl. xx. ff. 32 & 34 (*not* ff. 33 & 35).
1843. *Goniatites Looneyi* (pars), J. Morris, Cat. Brit. Foss. p. 180.
1848. *Goniatites Looneyi* (pars), H. G. Bronn, Gesch. d. Natur, vol. iii. p. 543.
1849. *Goniatites discrepans*, T. Brown, Foss. Conch. p. 28, pl. xxi. ff. 8 & 15.
1850. *Aganides Looneyi* (pars), A. d'Orbigny, Prod. de Paléont. stratigr. vol. i. p. 114.
1852. *Ammonites Looneyi* (pars), C. G. Giebel, Fauna der Vorwelt, vol. iii. pt. i. p. 484.
1854. *Goniatites Looneyi* (pars), J. Morris, Cat. Brit. Foss. 2nd ed. p. 304.
1884. *Dimorphoceras Looneyi* (pars), A. Hyatt, Proc. Boston Soc. Nat. Hist. vol. xxii. p. 331.
1888. *Goniatites Looneyi* (pars), R. Etheridge, Brit. Foss. vol. i., Palæozoic, p. 312.

Sp. Char. Shell small, subglobose, involute; greatest thickness near the umbilicus, about three-fifths of the diameter of the shell; height of outer whorl nearly two-thirds of the diameter of the shell. Whorls few (? number); inclusion complete; umbilicus minute, depressed. Whorl oval in section, about as high as wide; considerably indented by the preceding whorl; periphery narrowly rounded; sides feebly convex; no distinct inner area. Body-chamber (? length). Chambers very shallow, seventeen or eighteen in the last whorl of

the septate portion; suture-line as in fig. 106. Test thin, ornamented with delicate striæ, which, passing backwards from the umbilicus, form a shallow forwardly-concave sinus on the lateral area, and a wide fairly-deep sinus on the periphery; these are crossed by very obscure longitudinal lines.

Fig. 106.



Suture-line of *Dimorphoceras discrepans*. Drawn of twice the natural size from a specimen in the Gilbertson Collection, British Museum.

As intimated by Holzapfel [1] and by Karpinsky [2], Phillips included in his *G. Looneyi* at least two distinct species. Brown first observed this and retained Phillips's name for the species represented in figs. 33 & 35; while he named the species depicted in figs. 32 & 34 *Goniatites discrepans*. Phillips's types were in the Looney Collection; but the Gilbertson Collection, now in the British Museum, contains good examples, and from these the above description has been chiefly drawn up.

Size. The largest specimen in the Collection is 12·5 mm. in diameter and has only the base of the body-chamber.

Form. & Loc. Carboniferous: Yorkshire.

97364. Six specimens, ranging in diameter from 3·5 to 4·5 mm.; Vale of Todmorden.
Presented on behalf of the late Mr. John Rofe, 1878.

C. 256. Six examples, ranging in diameter from 3 to 12·5 mm.; High Green Wood, Yorkshire. *Gilbertson Coll.*

C. 5293. A series of examples, ranging in diameter from 1 to 6 mm.; Halifax, Yorkshire. *Purchased*, 1895.

C. 5301. Four examples, ranging in diameter from 3 to 4·5 mm.; Vale of Todmorden. *History unknown.*

C. 5399. A specimen, 10·5 mm. in diameter; its suture-line is figured in fig. 106: Carboniferous, locality not recorded.
History unknown.

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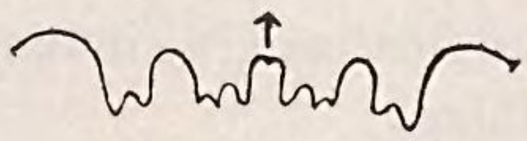
[1] Palæont. Abhandl. Dames & Kayser, vol. v. 1, 1889, p. 38.
[2] Mém. Acad. Imp. Sci. St. Pétersbourg, [7], vol. xxvii. no. 2, 1889, p. 81.

Dimorphoceras Looneyi (J. Phillips).

1836. *Goniatites Looneyi* (pars), J. Phillips, Geol. Yorks. pt. ii. p. 236, pl. xx. ff. 33, 35 (*not* ff. 32 & 34).
1843. *Goniatites Looneyi* (pars), J. Morris, Cat. Brit. Foss. p. 180.
1848. *Goniatites Looneyi* (pars), H. G. Bronn, Gesch. d. Natur, vol. iii. p. 543.
1849. *Goniatites Looneyi*, T. Brown, Fossil Conch. p. 28, pl. xxi. ff. 1, 2, 3.
1850. *Aganides Looneyi* (pars), A. d'Orbigny, Prod. de Paléont. stratigr. vol. i. p. 114.
1852. *Ammonites Looneyi* (pars), C. G. Giebel, Fauna der Vorwelt, vol. iii. p. 484.
1854. *Goniatites Looneyi* (pars), J. Morris, Cat. Brit. Foss. 2nd ed. p. 304.
1884. *Dimorphoceras Looneyi* (pars), A. Hyatt, Proc. Boston Soc. Nat. Hist. vol. xxii. p. 331.
1888. *Goniatites Looneyi* (pars), R. Etheridge, Brit. Foss. vol. i., Palæozoic, p. 312.
1889. *Thalassoceras Looneyi*, A. Karpinsky, Mém. Acad. Imp. Sci. St. Pétersbourg, [7], vol. xxvii. no. 2, p. 81.

Sp. Char. Shell small, subglobose, involute; greatest thickness at the umbilicus, a little more than three-fifths of the diameter of the shell; height of outer whorl three-fifths of the diameter of the shell. Whorls few (? number); inclusion almost complete; umbilicus very minute. Whorl oval in section, a little wider than high; indented to about one-third of its height by the preceding whorl; periphery narrowly convex; sides feebly convex, passing imperceptibly into the umbilicus without forming any distinct inner area. Body-chamber (? length). Chambers shallow, suture-line as in fig. 107. Test not seen; the internal cast with obscure transverse striæ, which are slightly waved on the lateral area and form a wide and not very deep sinus on the periphery.

Fig. 107.



Suture-line of *Dimorphoceras Looneyi*. Drawn from a specimen in the British Museum and enlarged five times.

This species differs from *Dimorph. discrepans* in its relatively greater thickness, its prominent umbilical region, and the form of its suture-line. The above figure of the suture-line resembles very closely that given by Phillips in his fig. 35.

Karpinsky (*loc. cit.*) places this species in Gemmellaro's genus

Thalassoceras[1]; but while agreeing with Gemmellaro in regarding *Thalassoceras* as descended from *Dimorphoceras*, we think Phillips's species belongs more properly to *Dimorphoceras*, in which genus it was placed by Hyatt.

Size. Only one example has been recognized in the Collection; it shows the base of the body-chamber and has a diameter of 5 mm.

Form. & Loc. Carboniferous; Halifax, Yorkshire.

C. 5293 a. The example referred to above. *Purchased*, 1895.

Dimorphoceras carina (L. G. de Koninck).

1843. *Goniatites carina*, L. G. de Koninck in J. J. d'Omalius d'Halloy, Précis elem. géol. p. 515 (*not* of Phillips)[2].

1842–44. *Ammonites carina*, L. G. de Koninck, Descr. Anim. Foss p. 582, pl. l. ff. 4 *a–c*.

1848. *Goniatites carina* (pars), H. G. Bronn, Gesch. d. Natur, vol. iii. p. 541.

1850. *Aganides carina* (pars), A. d'Orbigny, Prod. de Paléont. stratigr. vol. i. p. 116.

1852. *Ammonites carina*, C. G. Giebel, Fauna der Vorwelt, vol. iii. p. 463.

1878. *Goniatites carina* (pars), J. J. Bigsby, Thesaur. dev.-carb. p. 337.

1882. *Goniatites carina* (pars), L. G. de Koninck, Faune Calc. Carb. de la Belgique (Ann. Mus. Roy. d'Hist. nat. de Belgique, sér. Paléont. vol. v.), pt. ii. p. 116, pl. l. ff. 13, 13 *a*.

Sp. Char. Shell small, lenticular; greatest thickness at the umbilicus, about one-half of the diameter of the shell; height of outer whorl about two-thirds of the diameter of the shell. Whorls five or six; inclusion complete; umbilicus closed. Whorl sub-triangular in section, higher than wide; indented to about two-fifths of its height by the preceding whorl; periphery narrowly convex; sides flattened, prominent at the umbilicus; no definite inner area. Body-chamber (? length). Chambers shallow; (for suture-line see fig. 108). Test smooth.

Fig. 108.

Suture-line of "*Goniatites*" *carina*; enlarged.
After de Koninck.

In its general form and in the character of its suture-line (so far

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[1] "Fauna dei calcari con Fusulina della valle del fiume Sosio": Giorn. Sci. nat. ed econ. Palermo, vol. xix. 1888, p. 67.

[2] See *infrà*, p. 279.

as can be made out), the specimen in the Collection greatly resembles *Dimorphoceras Gilbertsoni*; we have not, however, much doubt in referring it to the genus *Dimorphoceras*. We strongly suspect that de Koninck's figure of the suture-line is not quite accurate.

De Koninck's species is not the same as Phillips's *G. carina*, the latter being umbilicated; strictly therefore it should receive another name, but in the absence of information respecting some characters of this species we have refrained from introducing a name, which there is reason to believe might prove to be a synonym.

Size. Shell attaining a diameter of more than 15 mm.

Form. & Loc. Calcaire de Visé (Assise VI.) = Carboniferous Limestone: Visé, Belgium.

64868. Entirely septate example, 15 mm. in diameter, labelled "*Goniatites carina*" in de Koninck's handwriting.
Purchased, 1868.

The following is probably referable to this genus:—

C. 258. An imperfect, almost entirely septate specimen, about 30 mm. in diameter, the suture-line of which is, however, exceedingly difficult to trace. Carboniferous Limestone: Bolland. *Gilbertson Coll.*

Genus **GASTRIOCERAS,** A. Hyatt[1].

Syn. *Ammonites*, W. Martin, 1809[2] (pars), et auct.; *Goniatites*, J. Phillips, 1836[3] (pars), et auct.; *Aganides*, A. d'Orbigny, 1850[4] (pars).

Type. *Goniatites Listeri*[5], J. Phillips, Geol. Yorkshire, pt. ii. 1836, p. 235, pl. xx. f. 1.

Gen. Char. Shell umbilicated, its whorls usually with longitudinal striæ, often also with transverse ribs, and with tubercles at the umbilical margin; periphery broadly rounded, with constrictions. Suture-line: external (outer or peripheral) lobe broad and deep, divided by a median saddle; first lateral lobe deep, linguiform, angular; second lateral lobe small, angular, situated upon the umbilical margin or upon the inner area.

Carboniferous and Permo-Carboniferous.

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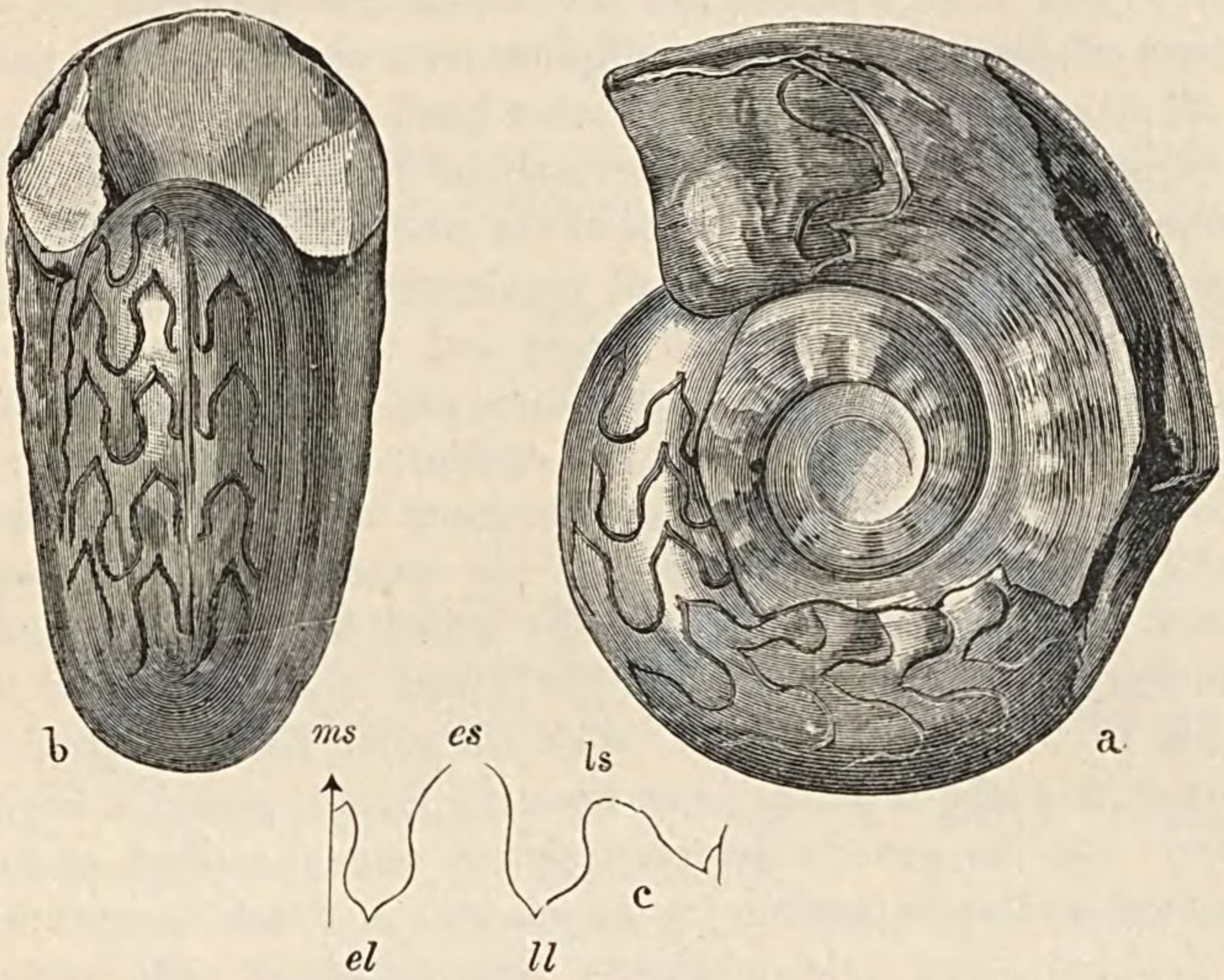
[1] Proc. Boston Soc. Nat. Hist. vol. xxii. p. 327 (1884).
[2] Petrificata Derbiensia, pl. xxxv. f. 3 & p. 16.
[3] Geol. Yorks. pt. ii. p. 235, pl. xx. f. 1.
[4] Prod. de Paléont. stratigr. vol. i. p. 116.
[5] Although not designated the type, this is the first-mentioned species.

The very close relationship existing between some of the forms of Hyatt's genus *Glyphioceras* and those of the same author's

Fig. 109.



Gastrioceras Jossæ.—*a*, lateral view, showing the ornaments of the test and the suture-line: *b*, front view: *c*, suture-line—*ms*, median saddle; *el*, external, outer or peripheral lobe; *es*, external, outer or peripheral saddle; *ll*, lateral lobe; *ls*, lateral saddle. Natural size. Drawn from a specimen in the British Museum Collection.

Gastrioceras has already been pointed out by Karpinsky[1], whose observations are to the following effect. The most important distinction between the typical forms of *Gastrioceras* and the typical forms of *Glyphioceras* consists in the trapezoidal section of the whorls of the former, in the development of ribs, tubercles, or nodes on the sides, in the broad umbilicus, and in the presence of a second lateral lobe or division of the lateral saddle. This distinction is perfectly apparent between such forms as *Gastrioceras Jossæ* (de Vern.) and *Glyphioceras complicatum* (de Koninck); but the comparison of a large number of forms shows that not one of these features is characteristic, and that the nature of the suture-line does not afford a generic distinction. In *Gastrioceras Jossæ* (de Vern.) the section of the whorl becomes trapezoidal in different individuals at different stages of growth. In most young specimens

[1] Mém. Acad. Sci. St. Pétersbourg, ser. 7, vol. xxxvii. 1890, no. 2, p. 45 *et seq.*

the transverse section of the whorl is semielliptical or semicircular, the inner area being nearly perpendicular to the plane of symmetry; with age the periphery becomes more flattened and relatively wider, and the inner area of the whorl becomes more oblique and forms a side of the trapezoidal cross-section. In other species of *Gastrioceras* the semielliptical form of cross-section persists at all stages of growth. On the other hand the whorl in the young of *Glyphioceras diadema* has a trapezoidal cross-section. In several species of *Gastrioceras* the sides of the whorls do not possess either ribs or tubercles. The degree of involution of the shell is also not a constant character in *Gastrioceras* and *Glyphioceras*. The only character which serves to separate these two genera is the secondary lobe in the lateral saddle; but this appears to be merely the small lobe which in some cases is on the inner area, in others on the umbilical margin, and in others on the lateral area of the whorl. When the transverse section of the whorl is trapezoidal and the secondary lateral lobe occurs on the lateral area, the species is referred to *Gastrioceras*, but if, with the same shape of transverse section, this lobe is on the inner area, the form is placed in *Glyphioceras*. But the generic determination of some described species is rendered almost impossible by the manner in which the suture-line is depicted, some palæontologists representing it only as far as the umbilical margin, others as far as the suture of the shell; in the former case the lobe on the inner area of the whorl would not be represented. Again, when this secondary lobe occurs on the lateral area as in *Gastrioceras*, and the whorl is compressed, the species is referred to *Paralegoceras*. Karpinsky sees no ground for generic distinction between these forms, although amongst them can be recognized certain groups of species; *e. g.* the ribbed or tuberculated forms, which are referred to the genus *Gastrioceras*, the typical species of *Glyphioceras*, and the forms which Hyatt refers to the genus *Paralegoceras*. Karpinsky is disposed to regard the typical form of the latter as a distinct genus or a subgenus, and whilst adopting the other two names does not consider them to be of generic significance.

We may remark that in the examples that are here referred to three of the species which Hyatt places in *Gastrioceras*, viz., *G. Listeri*, *G. Marianum*, and *G. Jossæ*, the second lateral lobe is on the inner area of the whorl. The affinities between *Glyphioceras* and *Gastrioceras* are certainly very close, but we have, provisionally at least, kept them distinct.

Gastrioceras carbonarium (v. Buch).

?1820. *Ammonites subcrenatus*, E. F. v. Schlotheim, Petrefaktenkunde, pl. xi. f. 9.

1830. *Ammonites subcrenatus*, F. W. Hoeninghaus, Jahrb. für Mineral. p. 239. [*Nom. nud.*]

1831. *Ammonites subcrenatus*, G. Münster, Jahrb. für Mineral. p. 371. [*Nom. nud.*]

1832. *Ammonites carbonarius* (pars), L. v. Buch, Phys. Abhandl. d. k. Akad. d. Wissensch. Berlin, for 1830, p. 176, pl. ii. f. 9^{iv} (excl. ff. 9, 9′–9‴).

1842. *Goniatites carbonarius* (pars), d'Archiac & de Verneuil, Trans. Geol. Soc. [2], vol. vi. p. 382.

1842–44. *Ammonites Listeri*, L. G. de Koninck, Descr. Anim. Foss. p. 577, pl. li. ff. 4 *a*, *b*.

1848. *Goniatites Listeri* (pars), H. G. Bronn, Gesch. d. Natur, vol. iii. p. 542.

1861. *Goniatites Listeri*, J. W. Salter, Mem. Geol. Surv., Iron Ores of Great Britain, pt. iii. (Iron Ores S. Wales), p. 221, pl. i. ff. 35, 36.

1863. *Goniatites Listeri* (pars), F. Roemer, Zeitschr. deutsch. geol. Gesell. vol. xv. p. 580.

1884. "*Ammonites carbonarius*, L. v. Buch," E. Beyrich, Zeitschr. deutsch. geol. Gesell. vol. xxxvi. p. 213.

1884. *Glyphioceras carbonarium* (pars), A. Hyatt, Proc. Boston Soc. Nat. Hist. vol. xxii. p. 329.

1890. *Goniatites Listeri*, J. Ward, Trans. N. Staffs. Inst. Mining & Mech. Engin. vol. x. pl. i. ff. 4, 5.

1892. *Goniatites Listeri*, G. Wild, Trans. Manchester Geol. Soc. vol. xxi. p. 396, pl. ii. figs. 9, 10.

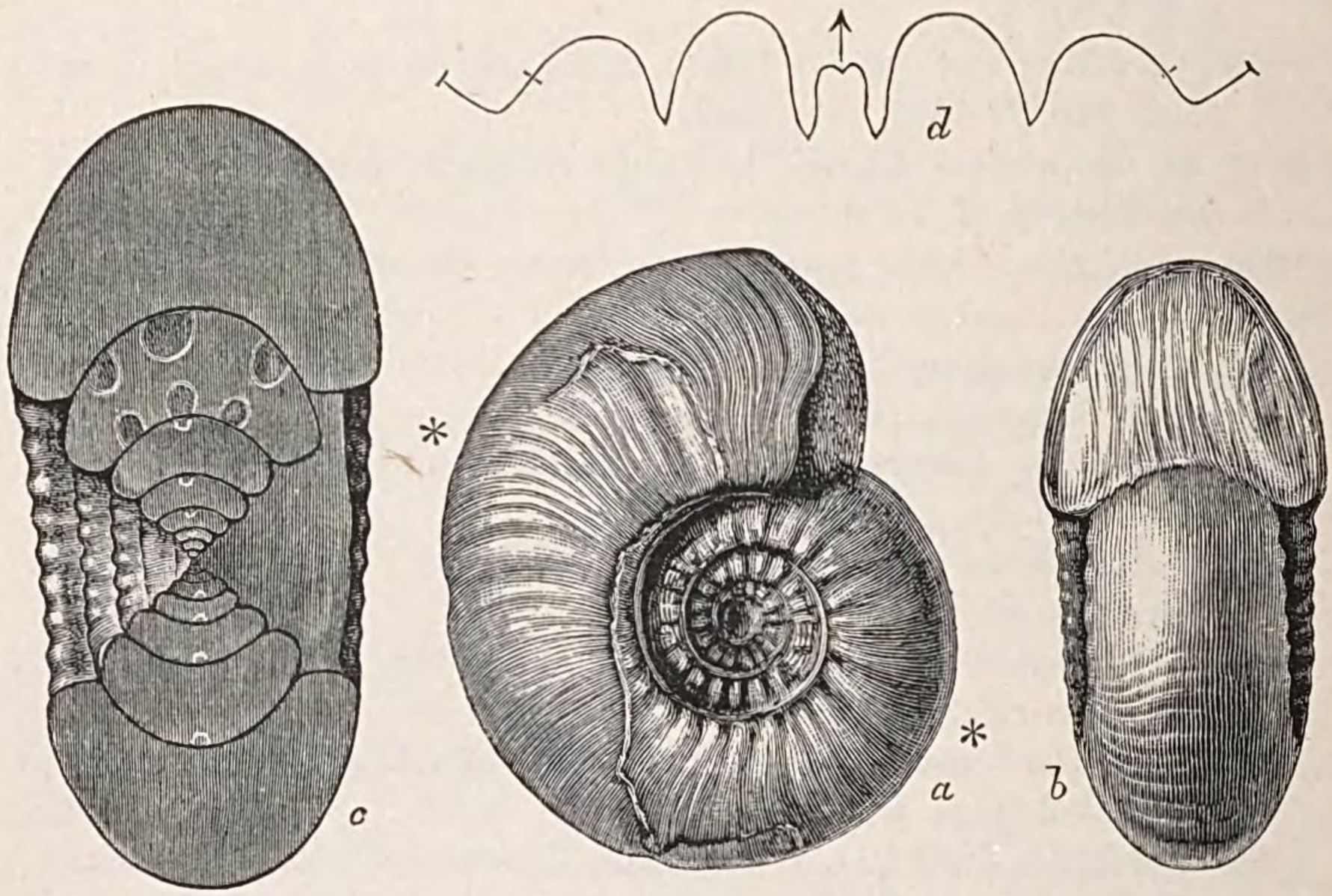
1896. *Goniatites carbonarius*, H. Bolton, Trans. Manchester Micros. Soc. 1895, pp. 130, 134, pl. ii. f. 20.

[*Not* 1840. *Goniatites carbonarius*, J. de C. Sowerby, Trans. Geol. Soc. [2], p. 703*, pl. lii. ff. 8, 9.]

Sp. Char. Shell subdiscoidal, somewhat compressed, widely umbilicated; greatest thickness at the umbilical margin, from five-ninths (in the compressed form) to about two-thirds (in the inflated form) of the diameter of the shell; height of outer whorl from about four-elevenths (in the compressed form) to about three-eighths (in the inflated form) of the diameter of the shell. Whorls seven or eight; inclusion from about three-fifths (in the compressed form) to three-fourths (in the inflated form); umbilicus deep, with steep sides and subangular tuberculated margin, from about four-elevenths (in the compressed form) to nearly two-fifths (in the inflated form) of the diameter of the shell in width. Whorl semilunate in section, wider than high; indented to nearly one-third of its height by the preceding whorl; periphery more or less broadly convex, continuous with the sides; sides feebly convex, a

little flattened near the umbilicus; inner area well-defined, steep, a little steeper in the compressed than in the inflated form. Body-chamber occupying a little more than the last whorl; aperture with a wide and fairly deep peripheral sinus. Chambers rather shallow; suture-line as in fig. 110 *d*. Test ornamented with fine simple striæ, which cross the lateral area in a forwardly-convex

Fig. 110.



Gastrioceras carbonarium.—*a*, lateral view of a compressed form, showing the border of the aperture; *b*, front view of same; *c*, transverse section at the diameter marked * * in fig. *a*, showing the variation in the form of the transverse section of the whorl at successive stages in the growth of the shell; *d*, the suture-line of another specimen where the diameter of the shell is 53 mm. Drawn from examples in the British Museum Collection (C. 5939 and C. 2273). *a* and *b* are two-thirds of the natural size; *c* and *d* are of the natural size.

curve, and form on the periphery a wide deep forwardly-concave sinus; in well-preserved specimens these striæ are feebly crenulated on the umbilical tubercles; the umbilical margin of each whorl with about twenty-three or twenty-four tubercles, from each of which an obscure forwardly directed rib passes nearly across the inner area of the whorl; these tubercles are crossed by very fine and obscure longitudinal striæ, especially on the inner whorls, but they are not visible in internal casts. Internal casts with four or five constrictions following the direction of the lines of growth.

This species is usually united with *Gastrioceras Listeri* (Martin), but after a careful and prolonged examination of a large series

of specimens, we do not, judging by Martin's figure, consider them to belong to that species, or to be specifically identical with the examples which Sowerby has figured (and correctly, as we think) as Martin's species, and which are now in the National Collection. Not only do adult examples of *Gast. Listeri* and *G. carbonarium* differ considerably from each other, but there is also a great difference between the young. Further, among examples from the same locality, two forms of the present species can be recognized, the one being more inflated and also more widely umbilicated than the other. But since the general appearance—sculpture, &c.—of these two forms is the same, we regard these differences as merely sexual. Even in the inflated form, not only in the adult, but also in the very young, the whorls are much more compressed and the ornaments finer than in *Gastrioceras Listeri*. Hence we unite the two forms which present what may be merely sexual differences, and refer them to v. Buch's *carbonarius*, and we regard the more coarsely ornamented and more widely umbilicated form as Martin's species. The two species occur together, for we have seen them associated in a hand-specimen, but *G. carbonarium* appears to be much more common than *G. Listeri*.

L. v. Buch considered that the two specimens figured by Sowerby belonged to distinct species; the figure on the left he referred to Martin's *Listeri*, and that on the right to his own *carbonarius*; but, although the former specimen is somewhat crushed at its anterior extremity so that the true shape of the section of the whorl cannot be seen, we consider it is referable to the same species as the other example figured by Sowerby.

According to Beyrich, L. v. Buch's figures of *G. carbonarius* belong to distinct species, ff. 9′–9‴ being referable to *Gly. sphæricum* (Martin), 9^{iv} therefore alone referable to *G. carbonarius*. According to the same author, the latter is the same as the *Ammonites subcrenatus* of Schlotheim.

Prof. Hyatt refers *Gon. carbonarius* to the genus *Glyphioceras* and *Gon. Listeri* to *Gastrioceras*; but the similarity between the two species is so great that we think they should both be referred to the same genus, and hence we have included both in the genus *Gastrioceras*, of which the type is *G. Listeri*.

Size. Shell attaining a diameter of 160 mm.

Form. & Loc. Lower Coal Measures: Halifax, Yorkshire; Burnley Moor, Lancashire; Instow, North Devon. Carboniferous: Vale of Todmorden, Yorkshire; "Shibden"; "Swan Bank Pit."

41599 a. Three examples, ranging in diameter from 22 to 35 mm. Halifax. *Purchased*, 1865.

43909 a. Example of the broad form, 15·5 mm. in diameter; N. of Halifax. *Sowerby Coll.*

46778. Four specimens, ranging from 20 to 30 mm. in diameter; Shibden. *Purchased*, 1869.

50178. Five specimens, ranging from 18 to 32 mm. in diameter; Halifax (Hard bed). *Morris Coll.*

50181. Seven examples, ranging in diameter from 23 to 60 mm., some in matrix; Halifax, Yorkshire. *Morris Coll.*

50699. Imperfect specimen, 48 mm. in diameter; Halifax. *Morris Coll.*

51393. Three examples, ranging in diameter from 11 to 21·5 mm. Halifax. *Purchased*, 1867.

68082. Two specimens, 77 and 99 mm. in diameter respectively, the latter in matrix; also an example, 92 mm. in diameter, sectioned and polished, showing the length of the body-chamber: Burnley Moor, Lancashire. *Presented by Mrs. Morris.*

75129. Example 37 mm. in diameter; Yorkshire. *Toulmin-Smith Coll.*

75348. Widely-umbilicated specimen, 23 mm. in diameter, somewhat obscured by matrix; Caldbeck, Cumberland. *History unknown.*

97354. Four examples, ranging in diameter from 23 to 69 mm., the specimen 39 mm. in diameter exhibiting the suture-line; locality unrecorded. *Presented on behalf of the late Mr. John Rofe*, 1878.

C. 88. Plaster cast of a specimen, 160 mm. in diameter, from the Coal Measures of Halifax, Yorkshire. *Purchased*, 1881.

C. 106. Two well-preserved examples, 42 and 68 mm. in diameter respectively; Halifax. *Purchased*, 1880.

C. 246. Six specimens, ranging in diameter from 26 to 51 mm., the largest being widely umbilicated and approaching *G. Listeri*; also several very small specimens and some fragments. Halifax. *Gilbertson Coll.*

C. 300. Three specimens, ranging in diameter from 22 to 56 mm., their umbilical margins with very small and faint tubercles; Shibden. *Purchased*, 1882.

C. 1613. Small block containing impressions of several specimens, the largest being about 22 mm. in diameter; Instow, North Devon (Fish Bed). *Purchased*, 1886.

C. 2273. Pyritized internal cast, 81 mm. in diameter, the outer whorl occupied by the body-chamber. The last septum is figured above (fig. 110 *d*, p. 230). Lancashire. *Purchased*, 1888.

C. 5289 a. Broad, widely-umbilicated specimen, 20 mm. in diameter; Halifax. *Purchased*, 1895.

C. 5779. Three examples, ranging in diameter from 20 to 23 mm.; Swan Bank Pit. *History unknown.*

C. 5780. Two examples of the widely umbilicated form, 13·5 and 15 mm. in diameter respectively; Vale of Todmorden. *History unknown.*

C. 5939. Three specimen, 34, 65, and 75 mm. in diameter respectively; the medium-sized example is figured in fig. 110 *a*, *b*, *c*. Halifax. *Presented by Dr. Wheelton Hind*, 1897.

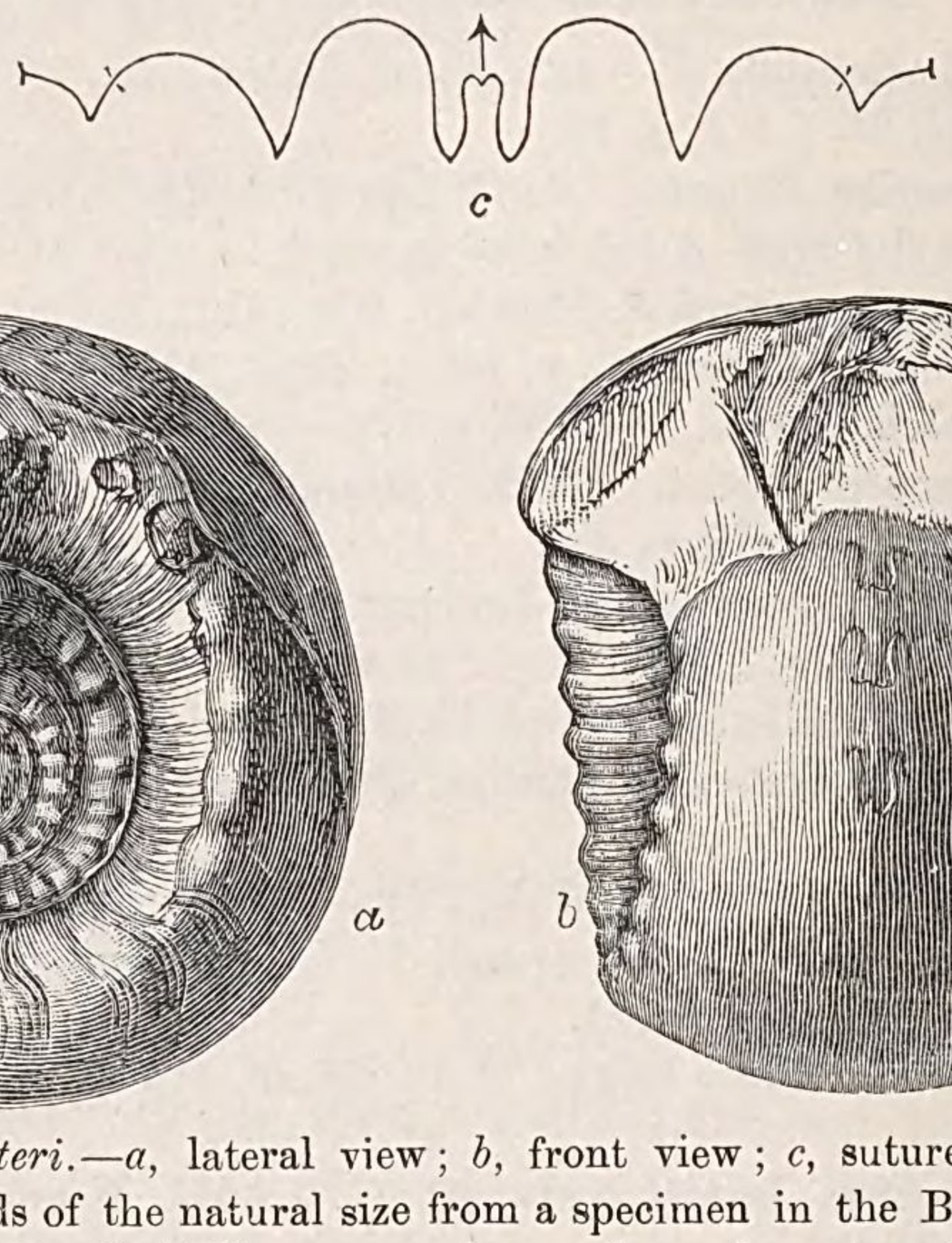
Gastrioceras Listeri (W. Martin).

1809. Conchyliolithus N. Ammonites (*Listeri*) &c., W. Martin, Petref. Derb. pl. 35. f. 3 & p. 16.
1825. *Ammonites Listeri*, J. de C. Sowerby, Min. Con. vol. v. p. 163, pl. di. f. 1 (right- & left-hand figures).
1828. *Ammonita Listeri*, J. Fleming, Hist. Brit. Anim. p. 247.
1832. *Ammonites Listeri*, L. v. Buch, Phys. Abhandl. d. k. Akad. d. Wissensch. Berlin, for 1830, p. 175.
1832. *Ammonites Listeri*, A. H. Dumont, Mém. Cour. Acad. Roy. Bruxelles, vol. viii. p. 356.
1832. *Ammonites sacer*, A. H. Dumont, ibid. p. 356 (fide Davreux).
? 1833. *Ammonites Listeri*, C. J. Davreux, Mém. Cour. Acad. Roy. Bruxelles, vol. ix. p. 270, pl. iii. ff. 1, 2.
1836. *Goniatites Listeri*, J. Phillips, Geol. Yorks. pt. ii. p. 235, pl. xx. ff. 1, 1 *a*.
1842. *Goniatites Listeri*, F. M'Coy, Synop. Carb. Foss. Ireland, p. 14.
1842–44. *Ammonites Listeri* (pars), L. G. de Koninck, Descr. Anim. Foss. p. 577 (excl. figs.).
1848. *Goniatites Listeri* (pars), H. G. Bronn, Gesch. d. Natur, vol. iii. p. 542.
1852. *Ammonites Listeri* (pars), C. G. Giebel, Fauna der Vorwelt, vol. iii. p. 475.
? 1855–57. *Goniatites Listeri*, J. Kelly, Journ. Geol. Soc. Dublin, vol. vii. p. 7.
1863. *Goniatites Listeri* (pars), F. Roemer, Zeitschr. deutsch. geol. Gesell. vol. xv. p. 580 (excl. figs.).

1884. "*Ammonites Listeri*, L. v. Buch," E. Beyrich, Zeitschr. deutsch. geol. Gesell. vol. xxxvi. p. 213.
1884. *Gastrioceras Listeri*, A. Hyatt, Proc. Boston Soc. Nat. Hist. vol. xxii. p. 327.
1888. *Goniatites Listeri*, R. Etheridge, Brit. Foss. vol. i., Palæozoic, p. 312.
1888. *Gastrioceras Listeri*, M. Tzwetaev, Mém. Com. géol. St. Pétersbourg, vol. v. no. 3, p. 1.
1890. *Glyphioceras Listeri* (pars), G. Steinmann & L. Döderlein, Elem. d. Paläont. pt. ii. p. 393.
1892. *Goniatites striatus*, G. Wild, Trans. Manchester Geol. Soc. vol. xxi. p. 396, pl. ii. f. 11.
1896. *Goniatites Listeri*, H. Bolton, Trans. Manchester Micros. Soc. 1895, pp. 130, 134, pl. ii. f. 21.
[*Not* 1842–44. *Ammonites Listeri*, L. G. de Koninck, Descr. Anim. Foss. p. 577, pl. li. ff. 4 *a*, *b*.—1880. *Goniatites Listeri*, Ferd. Roemer, Palæontogr. vol. xxvii. p. 10, pl. iii. ff. 6 *a*, *b*.]

Sp. Char. Shell globose, widely umbilicated; greatest thickness at the umbilical margin, about six-sevenths of the diameter of the shell; height of outer whorl rather more than three-tenths of the

Fig. 111.



Gastrioceras Listeri.—*a*, lateral view; *b*, front view; *c*, suture-line. Drawn of two-thirds of the natural size from a specimen in the British Museum Collection (No. C. 4953). *c*, was drawn from the suture-line where the diameter of the shell was 58·5 mm.

diameter of the shell. Whorls (? number); inclusion nearly one-half; umbilicus deep, about three-sevenths of the diameter of the

shell in width, with tuberculated margin. Whorl trapezoidal in section, nearly three times as wide as high; indented to about one-fourth of its height by the preceding whorl; periphery very broad, convex and continuous with the sides; inner area wide, convex, steep, sloping towards the umbilicus. Extent of body-chamber not seen, but at least one-half of the outer whorl. Chambers rather shallow, about twelve in the last half whorl of the septate part; suture-line as in fig. 111 *c*. Test with a row of tubercles at the umbilical margin, about twenty-three in the outer whorl, its surface with fine lines of growth which form on the periphery a very broad and shallow sinus; on the marginal tubercles these lines are very finely crenulate, and on the inner whorls crossed by fine longitudinal striæ; from each tubercle an obscure fold crosses the whorl in the same direction as the lines of growth, and a similar fold proceeds from each tubercle obliquely forward across the inner area. Outer whorl with one or two constrictions concurrent with the lines of growth.

Amongst the forms which we have referred to this species, the ornaments vary in strength, and the umbilicus differs in width; still those examples with the narrower umbilicus are much more widely umbilicated than examples of *Gastrioceras carbonarium*[1] of the same size. The latter species is much more common than *Gastrioceras Listeri*. The two species occur in association with each other.

Size. The largest specimen in the collection is 73·5 mm. in diameter.

Form. & Loc. Lower Coal Measures: Halifax and near Bradford, Yorkshire; Lancashire; and Instow, N. Devon.

41599 b. Example, 27 mm. in diameter, very much like the smaller of Sowerby's figured specimens; Halifax, Yorkshire. *Purchased*, 1865.

43909. Five specimens, ranging in diameter from 15 to about 40 mm., two of them being the specimens figured by Sowerby (*loc. cit.*); N. of Halifax. *Sowerby Coll.*

C. 62. Six small slabs bearing crushed examples possibly referable to this species; "roof of the Heaton and Shipley Coal Mines, two miles from Bradford, Yorkshire."
Transferred from Mus. Pract. Geol.

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[1] See remarks on this species, *suprà*, pp. 230, 231.

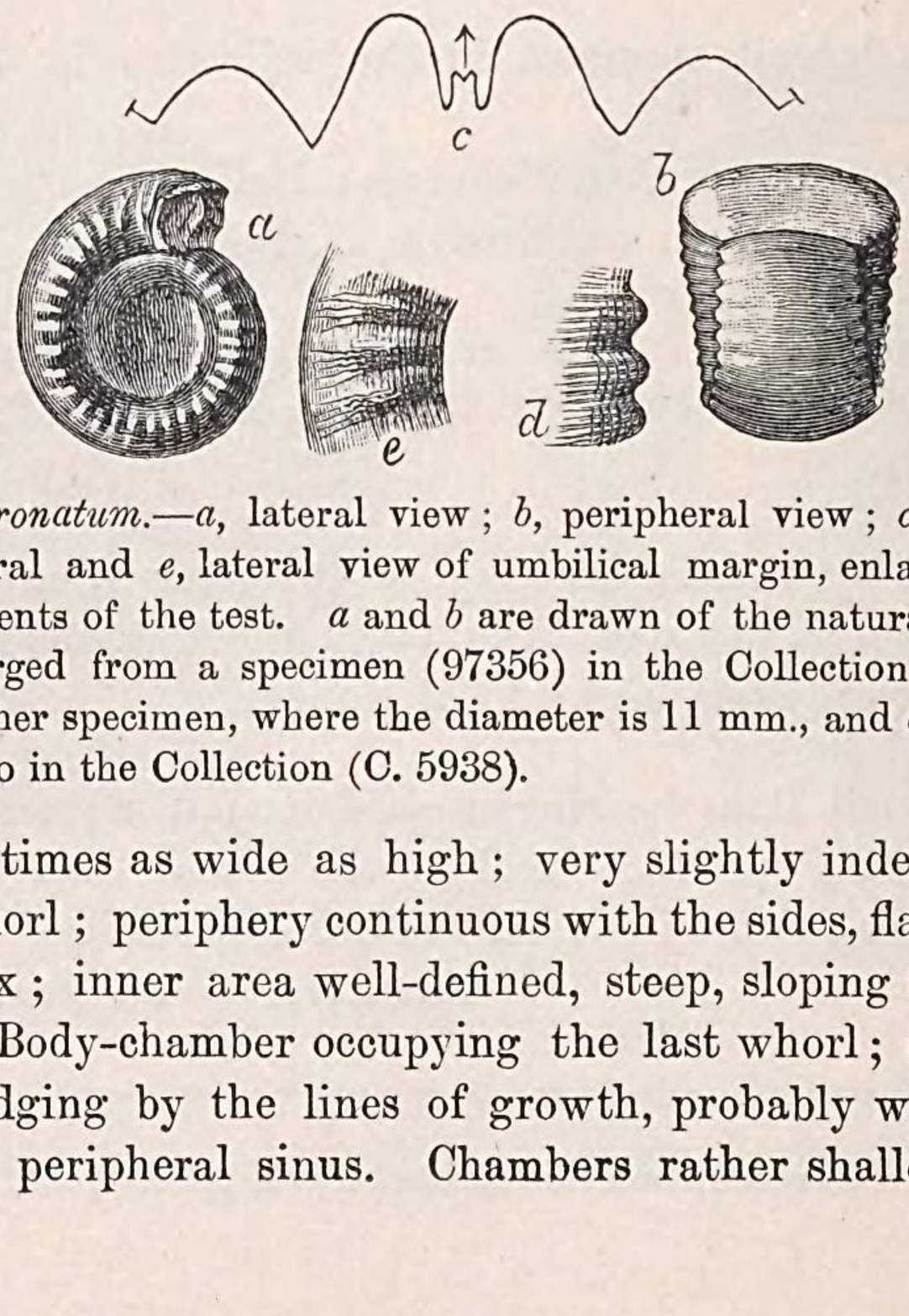
C. 1613a. Small block containing impressions of several specimens probably referable to this species; Instow (Fish Bed), N. Devon. *Purchased*, 1886.

C. 4953. A well-preserved example, 73·5 mm. in diameter, probably adult, figured in fig. 111 *a–c*. Its other dimensions are:—height of outer whorl, 23 mm.; ditto above preceding whorl, 18 mm.; thickness, 63 mm.; width of umbilicus (suture to suture), 30 mm.; ditto (margin to margin), 45 mm. The last two septa are very approximate, and the last half of the outer whorl is occupied by the body-chamber. Lancashire. *History unknown.*

Gastrioceras coronatum, sp. nov.

Sp. Char. Shell broad, widely umbilicated; greatest thickness at the umbilical margin, about four-fifths of the diameter of the shell; height of outer whorl about one-fourth of the diameter of the shell. Whorls (? number); inclusion nearly one-half; umbilicus deep, with subangular tuberculated margin, exposing the inner whorls, nearly three-fourths (measured at the suture of the shell) of the diameter of the shell in width. Whorl trapezoidal in section,

Fig. 112.



Gastrioceras coronatum.—*a*, lateral view; *b*, peripheral view; *c*, suture-line; *d*, peripheral and *e*, lateral view of umbilical margin, enlarged to show the ornaments of the test. *a* and *b* are drawn of the natural size; *d* and *e* are enlarged from a specimen (97356) in the Collection. *c* is drawn from another specimen, where the diameter is 11 mm., and enlarged three times; also in the Collection (C. 5938).

about three times as wide as high; very slightly indented by the preceding whorl; periphery continuous with the sides, flattened, very feebly convex; inner area well-defined, steep, sloping towards the umbilicus. Body-chamber occupying the last whorl; aperture not seen, but, judging by the lines of growth, probably with a broad, very shallow peripheral sinus. Chambers rather shallow; suture-

line as in fig. 112 *c*. Test thin, with a row of radially-elongated and somewhat forwardly-inclined tubercles at the umbilical margin, about thirty-three in the outer whorl ; its surface with exceedingly fine transverse striæ which are continued on to the inner area of the whorl, at the umbilical margin they are delicately fimbriated and crossed by longitudinal waved striæ (see fig. 112 *d* and *e*). The outer whorl with two constrictions parallel to the lines of growth.

This species is very closely allied to *Gastrioceras Listeri*, but in all stages of growth it has more depressed whorls, a broader and more flattened periphery, finer ornaments, and a wider umbilicus.

Size. Shell attaining a diameter of about 24 mm.

Form. & Loc. Lower Coal Measures : Bacup, Lancashire.

97356. Well-preserved example, 17·5 mm. in diameter, displaying the ornaments of the test ; figured of the natural size in fig. 112 *a*, *b* : Carboniferous ; locality not recorded.
Presented on behalf of the late Mr. John Rofe, 1878.

C. 5781. Specimen, 24 mm. in diameter, exhibiting portions of the shell-ornaments, and having the periphery more convex, and the sculpture coarser than the other examples : Carboniferous ; locality not recorded. *History unknown.*

C. 5782. Example, 6·5 mm. in diameter, with portion of the test : Carboniferous ; locality not recorded. *History unknown.*

C. 5938. Two specimens, 13 and 15 mm. in diameter respectively, the suture-line of the smaller is figured in fig. 112 *c* : Lower Coal Measures ; Bacup, Lancashire.
Presented by Herbert Bolton, Esq., 1897.

Gastrioceras Marianum (de Verneuil).

1845. *Goniatites Marianus*, de Verneuil, in Murchison, de Verneuil, & de Keyserling, Géol. Russie d'Europe, &c. vol. ii. p. 369, pl. xxvii. ff. 2 *a–c*.

1848. *Goniatites Marianus*, H. G. Bronn, Gesch. d. Natur, vol. iii. p. 543.

1850. *Aganides Marianus*, A. d'Orbigny, Prod. de Paléont. stratigr. vol. i. p. 116.

1852. *Ammonites Listeri* (pars), C. G. Giebel, Fauna der Vorwelt, vol. iii. p. 476.

1860. *Goniatites Marianus*, M. v. Grünewaldt, Mém. Acad. Imp. Sci. St. Pétersbourg, [7], vol. ii. no. 7, p. 136.

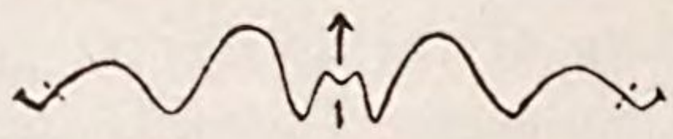
1860. *Goniatites Jossæ* (pars), E. d'Eichwald, Lethaea Rossica, vol. i. p. 1324.

1873. *Goniatites Listeri*, var. *Mariæ*, A. Gurow, Trudui Obshchest. istpuit. Khar'kov. Univ. vol. vii. (1873) p. 117.

1882. *Goniatites Listeri*, var. *Mariæ*, Val. de Moeller, Verhandl. Russ.-Kais. Mineral. Gesell. [2], vol. xvii. p. 13.
1884. *Gastrioceras Marianum*, A. Hyatt, Proc. Boston Soc. Nat. Hist. vol. xxii. p. 327.
1885. *Goniatites* (*Gastrioceras*, Hyatt) *Jossæ* (pars), P. Krotow, Trudui Obshchest. Estest. Kazansk. Univ. vol. xiii. p. 196.
1888. *Goniatites Jossæ* (pars), P. Krotow, Mém. Com. géol. St. Pétersbourg, vol. vi. p. 472.
1889. *Gastrioceras Marianum*, A. Karpinsky, Mém. Acad. Imp. Sci. St. Pétersbourg, [7], vol. xxxvii. p. 49, pl. iv. ff. 2 *a–c*.

Sp. Char. Shell rather small, inflated, widely umbilicated; greatest thickness at the umbilical margin, about two-thirds of the diameter of the shell; height of outer whorl about one-third of the diameter of the shell. Whorls six or seven; inclusion considerable, only the edge of the whorl exposed; umbilicus about three-fifths of the diameter of the shell in width, deep, with steep sides and an angular margin. Whorl semilunate in section, about two and a half times as wide as high; indented to about two-fifths of its height by the preceding whorl; periphery broadly convex and continuous with the convex sides; inner area sharply defined, narrow, very steep. Body-chamber occupying almost an entire whorl. Chambers shallow; suture-line as in fig. 113. Test with a row of

Fig. 113.



Suture-line of *Gastrioceras Marianum*, enlarged. After de Verneuil. The portion of the suture-line on the inner area of the whorl has been added from a specimen in the British Museum Collection.

small transversely-elongated tubercles at the umbilical margin, its surface ornamented with very fine transverse striæ, which form a wide deep backwardly-directed sinus on the periphery.

Size. The example figured by de Verneuil is 15 mm. in diameter and is entirely septate.

Form. & Loc. Carboniferous Limestone: Russia.

C. 5755. Two pieces of limestone containing three specimens 8, 11, and 15 mm. in diameter, somewhat more compressed than is indicated in de Verneuil's figure.

Transferred from Mus. Pract. Geol.

Gastrioceras Jossæ (de Verneuil).

[Fig. 109 *a*, *b*, *c*, p. 227.]

1845. *Goniatites Jossæ* (pars), de Verneuil, in Murchison, de Verneuil, & de Keyserling, Géol. Russie d'Europe, &c. vol. ii. p. 371, pl. xxvi. ff. 2 *a–e* (*not* ff. 3 *a*, *b*).

1848. *Goniatites Jossæ* (pars), H. G. Bronn, Gesch. d. Natur, vol. iii. p. 542.

1850. *Aganides Jossæ* (pars), A. d'Orbigny, Prod. de Paléont. stratigr. vol. i. p. 116.

1852. *Ammonites Jossæ* (pars), C. G. Giebel, Fauna der Vorwelt, vol. iii. p. 478.

1860. *Goniatites Jossæ* (pars), M. v. Grünewaldt, Mém. Acad. Imp. Sci. St. Pétersbourg, [7], vol. ii. no. 7, p. 137, pl. vi. f. 1.

1860. *Goniatites Jossæ* (pars), E. d'Eichwald, Lethaea Rossica, vol. i. p. 1324.

(?) 1862. *Goniatites Jossæ*, J. W. Salter, in Geol. Country around Bolton-le-Moors (Mem. Geol. Surv.), p. 34.

1874. *Goniatites Jossæ* (pars), A. Karpinsky, Verhandl. Russ.-Kaiserl. Mineral. Gesell. St. Petersburg, [2], vol. ix. p. 290.

1880. *Goniatites Jossæ*, W. Branco, Palæontogr. vol. xxvi. pl. v. ff. iii. *a–e*.

1884. *Gastrioceras Jossæ*, A. Hyatt, Proc. Boston Soc. Nat. Hist. vol. xxii. p. 327.

1885. *Goniatites* (*Gastrioceras*, Hyatt) *Jossæ* (pars), P. Krotow, Trudui Obshchest. Estest. Kazansk. Univ. vol. xiii. p. 196.

1888. *Gastrioceras Jossæ*, M. Tzwetaev, Mém. Com. géol. St. Pétersbourg, vol. v. no. 3, p. 1.

1888. *Goniatites Jossæ* (pars), P. Krotow, Mém. Com. géol. St. Pétersbourg, vol. vi. p. 472.

1889. *Gastrioceras Jossæ*, A. Karpinsky, Mém. Acad. Imp. Sci. St. Pétersbourg, [7], vol. xxxvii. p. 48.

1895. *Gastrioceras Jossæ*, K. A. v. Zittel, Grundzüge d. Palæont. p. 399.

Sp. Char. Shell discoidal, inflated, widely umbilicated; greatest thickness at a short distance from the inner edge of the whorl, nearly one-half of the diameter of the shell; height of outer whorl nearly one-third of the diameter of the shell. Whorls rather numerous (? number); inclusion about one-half; umbilicus about three-sevenths of the diameter of the shell in width, rather deep, with subangular margin, exposing the inner whorls. Whorl reniform in section, wider than high; indented to one-third of its height by the preceding whorl; periphery broadly convex, continuous with the sides; sides convex: inner area in the adult fairly well-defined, sloping towards the umbilicus; but in the young convex, not sharply defined, nearly at right angles to the plane of symmetry.

Body-chamber (? length). Chambers shallow, about nineteen or twenty in a whorl; suture-line as in fig. 109 *c* (p. 227). Test moderately thick, ornamented with close-set raised spiral striæ, which become more distinct with age; these are crossed by very fine transverse lines, which are much more distinct in the young shell; each whorl with from twenty-three to twenty-eight transversely elongated and somewhat forwardly inclined tubercles on the umbilical margin. Initial-chamber ellipsoidal, transversely elongate.

Size. Shell attaining a diameter of 100 mm.

Form. & Loc. Artinsk Stufe (Permo-Carboniferous): Perm, Russia.

C. 1493. A fairly well-preserved entirely septate example 67 mm. in diameter; River Kolwa, Perm, Russia.

Purchased, 1886.

C. 1499. Eight specimens ranging in diameter from 6 to 20 mm.; River Ufa, Perm. *Purchased*, 1886.

C. 1500. Two imperfect examples, and the impression of another showing the suture-line, the largest about 85 mm. in diameter; Krasnovfimsk, Perm, Russia.

Purchased, 1886.

C. 1505. Four fairly well-preserved specimens, ranging in diameter from 38 to 51·5 mm., the largest being figured in fig. 109 *a*, *b*, *c*, p. 227. Perm. *Purchased*, 1886.

Gastrioceras Suessi, A. Karpinsky.

1845. *Goniatites Jossæ* (pars), de Verneuil, in Murchison, de Verneuil, & de Keyserling, Géol. Russie d'Europe, &c. vol. ii. p. 371, ff. 3 *a*, *b* (*not* ff. 2 *a*–*e*).

1848. *Goniatites Jossæ* (pars), H. G. Bronn, Gesch. d. Natur, vol. iii. p. 542.

1850. *Aganides Jossæ* (pars), A. d'Orbigny, Prod. de Paléont. stratigr. vol. i. p. 116.

1852. *Ammonites Jossæ* (pars), C. G. Giebel, Fauna der Vorwelt, vol. iii. p. 478.

1860. *Goniatites Jossæ* (pars), M. v. Grünewaldt, Mém. Acad. Imp. Sci. St. Pétersbourg, [7], vol. ii. no. 7, p. 137.

1860. *Goniatites Jossæ* (pars), E. d'Eichwald, Lethaea Rossica, vol. i. p. 1324.

1874. *Goniates Jossæ* (pars), A. Karpinsky, Verhandl. Russ.-Kaiserl. Mineral. Gesell. St. Petersburg, [2], vol. ix. p. 290.

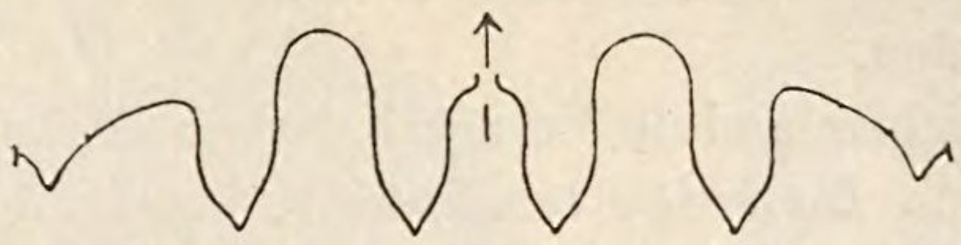
1885. *Goniatites* (*Gastrioceras*, Hyatt) *Jossæ*, P. Krotow, Trudui Obshchest. Estest. Kazansk. Univ. vol. xiii. no. 5, p. 196.

1888. *Goniatites Jossæ* (pars), P. Krotow, Mém. Com. géol. St. Pétersbourg, vol. vi. p. 472.

1889. *Gastrioceras Suessi*, A. Karpinsky, Mém. Acad. Imp. Sci. St. Pétersbourg, [7], vol. xxxvii. p. 52, pl. iii. ff. 3 *a-g*.

Sp. Char. Shell discoidal, slightly inflated, umbilicated; greatest thickness almost close to the umbilical margin, a little more than one-third of the diameter of the shell; height of outer whorl about two-fifths of the diameter of the shell. Whorls (? number); inclusion one-half; umbilicus about two-fifths of the diameter of the shell in width, relatively smaller in the young. Whorl semi-elliptical in section, rather wider than high; indented to nearly one-third of its height by the preceding whorl; periphery convex, continuous with the sides; sides flattened, feebly convex; inner area narrow, fairly well-defined, almost at right angles to the plane of symmetry. Body-chamber occupying at least a whorl. Chambers rather deep, about fifteen in a whorl; suture-line as in fig. 114. Test ornamented with spiral raised lines, which

Fig. 114.



Suture-line of *Gastrioceras Suessi*; natural size.
After Karpinsky.

become very prominent with age, the young also with raised transverse striæ, which in very young shells are stronger than the longitudinal lines; they form on the sides a sinus slightly concave forwards, and on the periphery a curve feebly convex forwards.

This species was first separated by Karpinsky from *Gastrioc. Jossæ*, with which it was usually united. It is more involute and compressed than that species, and lacks the prominent tubercles on the umbilical margin.

In the allied form *Gastrioceras sosiense*, Gemmellaro[1], the transverse striæ cross the periphery in a curve which is concave forwards and not convex, as in this species.

Size. Shell probably attaining a diameter of 130 mm.

Form. & Loc. Artinsk Stufe (Permo-Carboniferous): River Ufa, Perm, Russia.

C. 1499 a. Two examples, 10 and 15·5 mm. in diameter respectively. *Purchased*, 1886.

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[1] Giorn. Sci. Nat. ed Econom. Palermo, vol. xix. 1888, p. 88, pl. vii. ff. 17-19.

Family PROLECANITIDÆ.

(*Lanceolati, Linguati, Serrati,* Sandberger; *Irregulares,* Beyrich.)

Suture-line with several, sometimes numerous, lateral lobes and saddles. Peripheral lobe simple or divided.

SANDBERGEROCERAS, Hyatt[1].

Syn. *Goniatites,* d'Archiac & de Verneuil, 1842[2] (pars), et auct.; *Aganides,* A. d'Orbigny, 1850[3] (pars); *Ammonites,* C. G. Giebel, 1852[4] (pars); *Triainoceras,* A. Hyatt, 1884[5].

Type. *Goniatites tuberculoso-costatus,* G. & F. Sandberger, Verstein. rhein. Schichtensyst. Nassau, 1850–56, p. 64, pl. iv. ff. 1, 1 *a–f.*

Gen. Char. Discoidal, widely umbilicated; whorls with transverse costæ, periphery broad, convex. Suture-line with infundibuliform peripheral lobe and rounded lateral lobes.

Upper Devonian.

In 1842 d'Archiac and de Verneuil described the species *Goniatites costatus* and *Goniatites tuberculosus*, but G. & F. Sandberger, considering the former to be merely an internal cast of the latter, united them under the name *tuberculoso-costatus*, and figured several additional examples.

Hyatt makes *G. costatus*, d'Arch. & de Vern., the type of his *Triainoceras*, and the example of *Goniatites tuberculoso-costatus* figured by G. & F. Sandberger, pl. iv. f. 1, the type of his genus *Sandberge[r]oceras.*

Holzapfel[6], when describing his *Goniatites tuberculatus* (a *Gephyroceras*) from the Goniatiten-Kalke of Adorf, refers to it *G. tuberculosus*, d'Arch. & de Vern., *G. incertus*, d'Arch. & de Vern., and *G. tuberculoso-costatus*, G. & F. Sandberger (*op. cit.* pl. viii. f. 2), each with a query. This author therefore appears to separate *G. tuberculosus* from *G. costatus*, and the specimens of *G. tuberculoso-costatus* figured by G. & F. Sandberger on pl. iv. from the example

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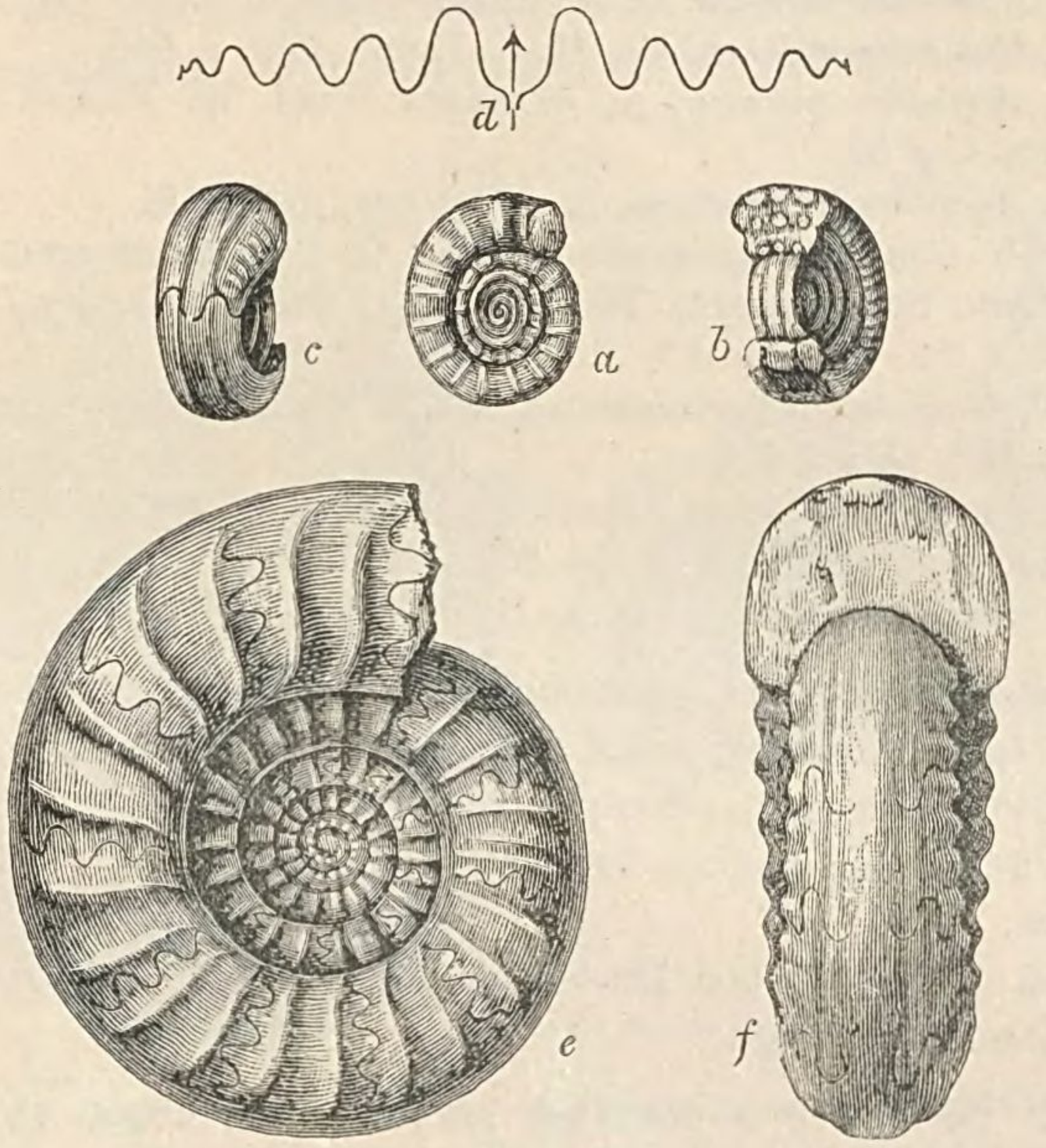
[1] Proc. Boston Soc. Nat. Hist. vol. xxii. 1884, p. 333.
[2] Trans. Geol. Soc. [2], vol. vi. p. 340.
[3] Prod. de Paléont. stratigr. vol. i. p. 59.
[4] Fauna der Vorwelt, vol. iii. p. 749.
[5] Proc. Boston Soc. Nat. Hist. vol. xxii. p. 336.
[6] Palæontogr. vol. xxviii. p. 20 (1882).

figured on pl. viii. under the same name. But, when writing somewhat later, this same author [1] states that Hyatt's *Triainoceras* and *Sandbergeroceras* are founded upon one and the same species.

In his 'Handbuch der Palæontologie,' Zittel adopts both *Sandbergeroceras* and *Triainoceras* (vol. ii. p. 421); but in his 'Grundzüge

Fig. 115.



Sandbergeroceras tuberculoso-costatum.—*a*, lateral view; *b*, antero-lateral view; *c*, periphero-lateral view; *d*, suture-line; *e*, lateral, and *f*, front view of the form described by d'Archiac and de Verneuil as *Gon. costatus*. *a–d* are copied from G. & F. Sandberger; *e*, *f*, from d'Archiac & de Verneuil, the external lobe being omitted.

der Palæontologie' (p. 400) he retains only the former and regards the latter as a synonym. We also have united these two genera, for, respecting the sole character (the form of the external or ventral lobe) by which Hyatt distinguished *Triainoceras* from *Sandbergeroceras*, d'Archiac and de Verneuil say "the artist has given to the drawing of this part of the chamber more precision than the state of the specimen justifies."

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[1] Palæont. Abhandl. Dames & Kayser, vol. v. 1, 1889, p. 19.

Sandbergeroceras tuberculoso-costatum (G. & F. Sandberger).

[Fig. 115 *a–f*, p. 243]

1842. *Goniatites costatus*, d'Archiac & de Verneuil, Trans. Geol. Soc. [2], vol. vi. p. 340, pl. xxxi. ff. 1, 1 *a*.
1842. *Goniatites tuberculosus*, d'Archiac & de Verneuil, ibid. p. 342, pl. xxvi. ff. 4, 4 *a*, *b*.
1848. *Goniatites costatus*, H. G. Bronn, Gesch. d. Natur, vol. iii. p. 541.
1848. *Goniatites tuberculosus*, H. G. Bronn, ibid. p. 546.
1850. *Aganides costatus*, A. d'Orbigny, Prod. de Paléont. stratigr. vol. i. p. 59.
1850. *Aganides tuberculosus*, A. d'Orbigny, ibid. p. 61.
1850–56. *Goniatites tuberculoso-costatus*, G. & F. Sandberger, Verstein. rhein. Schichtensyst. Nassau, p. 64, pl. iv. ff. 1, 1 *a–f*, pl. viii. ff. 2, 2 *a*.
? 1870. *Goniatites tuberculoso-costatus*, E. Tietze, Palæontogr. vol. xix. p. 130, pl. xvi. f. 6.
1884. *Sandberge[r]oceras tuberculosocostatum*, A. Hyatt, Proc. Boston Soc. Nat. Hist. vol. xxii. p. 333.
1884. *Triainoceras costatum*, A. Hyatt, ibid. p. 337.

The specimens in the collection which appear to us to be referable to this species do not reveal the characters of the species well enough to enable us to attempt a complete diagnosis.

Size. D'Archiac and de Verneuil figure an example 45 mm. in diameter.

Form. & Loc. Upper Devonian: Adorf, Waldeck; Oberscheld, near Dillenburg, Nassau.

C. 1782. Portion of a distorted internal cast, about 41 mm. in diameter, exhibiting some of the ornaments of the test; Oberscheld. *Presented by John Edward Lee, Esq.*, 1885.

C. 1840. A well-preserved but imperfect specimen, 10·5 mm. in diameter, in matrix, exhibiting the initial-chamber and the sculpture of the test, but no trace of the suture-line; Adorf. *Presented by John Edward Lee, Esq.*, 1885.

Genus **PROLECANITES**, E. v. Mojsisovics [1].

Syn. *Ellipsolites*, J. Sowerby [2], 1813 (pars), *not* of Montfort; *Ammonites*, J. Sowerby [3], 1820 (pars), et auct.; *Ammonellipsites*, J. Parkinson [4], 1822; *Planites*, de Haan [5], 1825 (pars); *Ceratites*,

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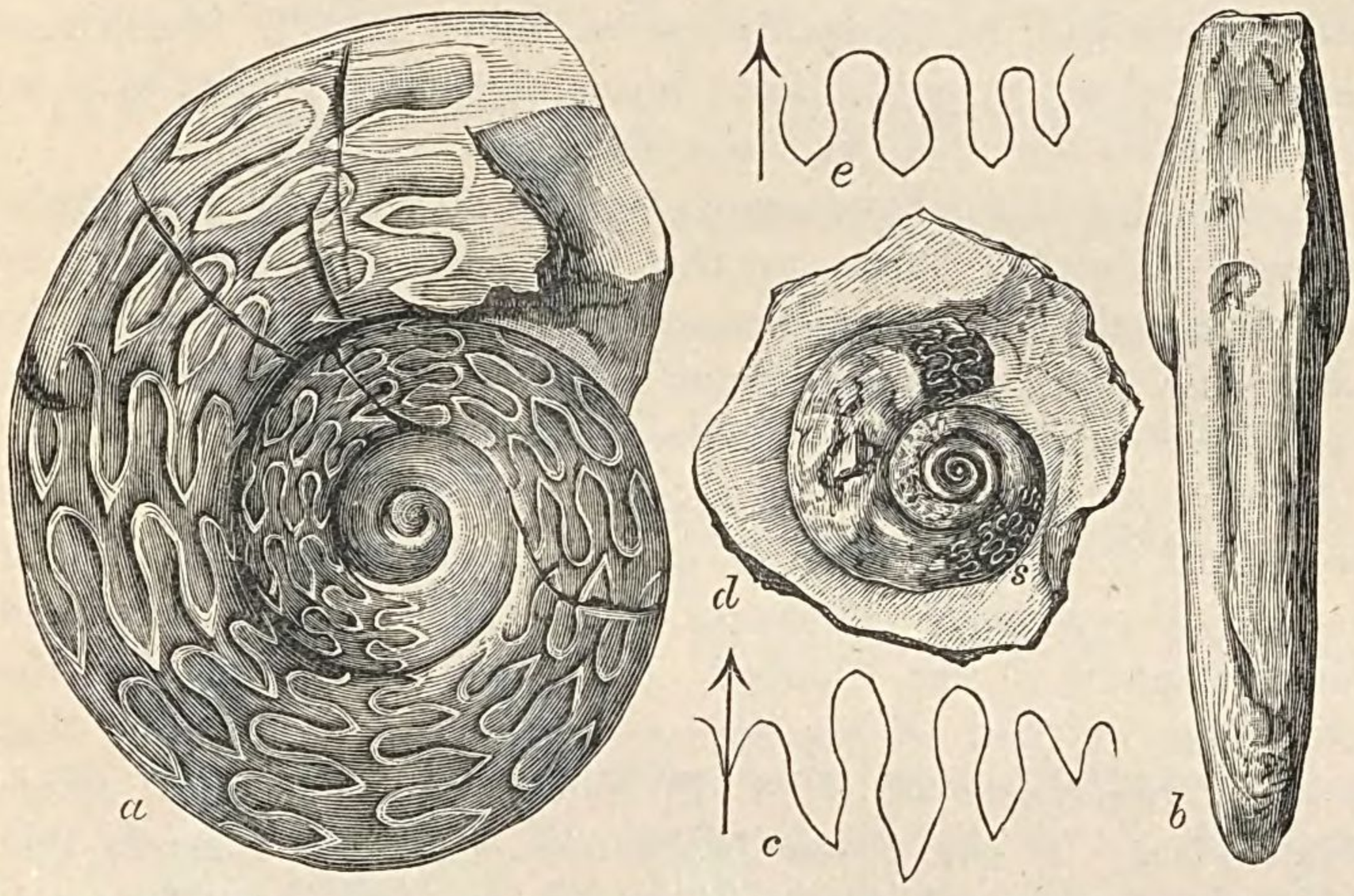
[1] Abhandl. d. k. k. geol. Reichsant. vol. x. 1882, p. 199.
[2] Min. Con. vol. i. p. 84, pl. xxxviii. [3] Ibid. vol. iii. p. 111, pl. cclxii.
[4] Introd. Foss. Org. Rem. pp. 164 & 233.
[5] Monog. Ammon. et Goniat. p. 93.

de Haan [1], 1825 (pars); *Nautilus*, J. Fleming [2], 1828 (pars), et auct.; *Goniatites*, L. v. Buch [3], 1832 (pars), et auct.; *Aganides*, A. d'Orbigny [4], 1850 (pars), et auct.; *Discites*, J. Morris [5], 1854 (pars), et auct.; *Pharciceras*, A. Hyatt [6], 1884 (pars).

Type. *Goniatites mixolobus*, G. & F. Sandberger, Verstein. rhein. Schichtensyst. Nassau, 1850–56, p. 67, pl. iii. f. 13 (*not* pl. ix. f. 6) [7].

Gen. Char. Shell more or less discoidal, slowly increasing, evolute, widely umbilicated, with compressed whorls having a narrow peri-

Fig. 116.



Prolecanites compressus.—*a*, lateral view of a specimen in the British Museum Collection, showing the suture-lines; *b*, peripheral view of a specimen in the collection of Miss C. Birley, showing the subangular edges of the periphery in the region of the body-chamber; *c*, suture-line, drawn from the specimen represented in *a*. *Prolecanites mixolobus.*—*d*, lateral view of Phillips's type-specimen in the Gilbertson Collection, British Museum; *e*, the suture-line marked *s* in *d*. *a* and *b* are each about three-eighths of the natural size; *c* is about one-half of the natural size; *d* is drawn of the natural size, and *e* is enlarged about five times.

phery, flattened sides, smooth test, and peculiar suture-line. Saddles entire, rounded, slightly constricted near their base, lobes obtusely

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[1] Monog. Ammon. et Goniat. p. 157. [2] Brit. Anim. p. 231.
[3] Phys. Abh. d. k. Akad. Wissenschaften, Berlin, for 1830, p. 171.
[4] Prod. de Paléont. stratigr. vol. i. p. 115.
[5] Cat. Brit. Foss. 2nd ed. p. 308.
[6] Proc. Boston Soc. Nat. Hist. vol. xxii. p. 336.
[7] This is the first species mentioned by Mojsisovics as belonging to the genus and is regarded by Hyatt as the type.

pointed. The external (outer or peripheral) lobe terminating in a single point; two and sometimes three lateral lobes present; auxiliary lobes absent, or very few; inner (or antiperipheral) narrow, deep, pointed, and on either side of it a very flat, broad, rounded lobe.

Devonian and Carboniferous.

Remarks.—Several of the synonyms of this genus are due to the fact of the identity of J. Sowerby's *Ellipsolites compressus* and *Ammonites Henslowi* [1].

Three genera proposed by Hyatt were *Pharciceras* [2], *Sandbergeroceras* [3], and *Triainoceras* [4]. The two latter were founded upon two of d'Archaic and de Verneuil's species which G. & F. Sandberger have pointed out to be identical; hence these two genera must be united, as has been done by Holzapfel, Frech, and Zittel.

Frech [5] also unites *Sandbergeroceras* and *Pharciceras* with *Prolecanites*. Holzapfel [6] points out that the former is distinguished by its strong sculpture and the arrangement of the inner portion of the suture-line, and hesitates to include it in the genus *Prolecanites*. Von Zittel [7] retains it as a separate genus.

Hyatt based his genus *Pharciceras* upon the species *Goniatites tridens* and *Gon. clavilobus* of G. & F. Sandberger, distinguishing it from *Sandbergeroceras* "by means of the divided ventral lobes and the smoothness of the whorls." But Frech points out that the suture-line of *Gon. tridens* does not materially differ from that of *Gon. lunulicosta* of G. & F. Sandberger, a species which Hyatt places in the genus *Prolecanites*, and also remarks that the form of the shell does not present any difference of generic importance.

Holzapfel is doubtful whether *Goniatites clavilobus* should be referred to *Prolecanites* or whether it should be retained for Hyatt's genus *Pharciceras*. We do not express an opinion on this point, for this species is not represented in the National Collection, and, according to Frech, the figure of it given by G. & F. Sandberger is not exact.

Mojsisovics regarded *Prolecanites* as the ancestor of *Lecanites* and

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[1] See Geol. Mag. [4], vol. i. 1894, p. 11.

[2] Proc. Boston Soc. Nat. Hist. vol. xxii. 1884, p. 336.

[3] Ibid. p. 333. Hyatt writes this name *Sandbergeoceras* instead of *Sandbergeroceras*.

[4] Ibid. p. 336.

[5] Abhandl. geol. Specialkarte Preussen &c. vol. viii. pt. 3, 1888, p. 26.

[6] Palæont. Abhandl. Dames & Kayser, vol. v. 1, p. 40.

[7] Grundzüge d. Palæont. 1895, p. 400.

placed both genera in the Lytoceratidæ; Hyatt included it in the family *Prolecanitidæ* which he instituted, and in this respect he is followed by von Zittel.

Prolecanites lunulicosta (G. & F. Sandberger).

1850–56. *Goniatites lunulicosta*, G. & F. Sandberger, Verstein. rhein. Schichtensyst. Nassau, p. 69, pl. iii. ff. 14, 14 *a–g*.
1851. *Goniatites lunulicosta*, G. Sandberger, Jahrb. natur. Verein. Nassau, p. 303, pl. iii. f. 36.
1852. *Ammonites Becheri* (pars), C. G. Giebel, Fauna der Vorwelt, vol. iii. p. 451.
1884. *Prolecanites lunulicosta*, A. Hyatt, Proc. Boston Soc. Nat. Hist. vol. xxii. p. 335.
1884. *Prolecanites lunulicosta*, K. A. Zittel, Handb. d. Palæont. vol. ii. p. 421, f. 579.
1884. *Goniatites lunulicosta*, E. Beyrich, Zeitschr. deutsch. geol. Gesell. vol. xxxvi. p. 211.
1888. *Goniatites* (*Prolecanites*) *lunulicosta*, F. Frech, Abhandl. geol. Specialkarte Preussen, &c. vol. viii. pt. 3, p. 27, pl. ii. ff. 3 *a*, *b*.
1889. *Prolecanites lunulicosta*, E. Holzapfel, Palæont. Abhandl. Dames & Kayser, vol. v. 1, p. 41.
1889. *Prolecanites lunulicosta*, G. Steinmann & L. Döderlein, Elem. d. Paläont. pt. ii. p. 395.
1895. *Prolecanites lunulicosta*, K. A. v. Zittel, Grundzüge d. Palæont. p. 400, f. 1087.

Sp. Char. Shell discoidal, widely umbilicated; greatest thickness at a short distance from the inner edge of the whorl, about one-fourth of the diameter of the shell; height of outer whorl rather more than two-fifths of the diameter of the shell. Whorls six or seven; inclusion one-half; umbilicus rather deep, about two-fifths of the diameter of the shell in width. Whorl subcordate in section, higher than wide; slightly indented by the preceding whorl;

Fig. 117.

Suture-line of *Prolecanites lunulicosta*; natural size.
After Sandberger.

periphery feebly convex, more convex in the young; sides feebly convex, concave near the periphery, continuous with the inner area; inner area convex, imperfectly defined, sloping towards the umbilicus. Body-chamber (? length); chambers rather shallow; suture-line as in fig. 117. Test rather thick; almost smooth on

the inner whorls, with occasional feeble simple lines of growth; on the outer whorl with close-set lines of growth, which on the concave portion near the periphery are accompanied by obscure folds convex forwards. 'Wrinkle layer' composed of very fine branching striæ.

Size. G. & F. Sandberger (*loc. cit.* pl. iii. f. 14) figure an example 65 mm. in diameter.

Form. & Loc. Upper Devonian (Kalk des Cypridinenschiefers): Oberscheld, Nassau.

C. 5403. An example, 15 mm. in diameter, in matrix. The label accompanying the specimen bears the name "F. Odernheimer." *Transferred from Mus. Pract. Geol.*

Prolecanites tridens (G. & F. Sandberger).

? 1842. *Goniatites latestriatus*, d'Archiac & de Verneuil, Trans. Geol Soc. [2], vol. vi. p. 341, pl. xxvi. f. 5.

1849. *Goniatites multiseptatus*, F. A. Quenstedt, Petrefact. Deutsch. vol. i. p. 64, pl. iii. f. 3 *a* (*not* of v. Buch).

1850–56. *Goniatites tridens*, G. & F. Sandberger, Verstein. rhein. Schichtensyst. Nassau, p. 66, pl. iv. ff. 2, 2 *a–e*; pl. ix. ff. 2, 2 *a*.

1851. *Goniatites tridens*, G. Sandberger, Jahrb. natur. Verein. Nassau, vol. vii. pts. 2 & 3, p. 296, pl. ii. f. 13.

1852. *Ammonites tridens*, C. G. Giebel, Fauna der Vorwelt, vol. iii. p. 479.

1884. *Pharciceras tridens*, K. A. Zittel, Handb. d. Palæont. vol. ii. p. 421.

1884. *Pharciceras tridens*, A. Hyatt, Proc. Boston Soc. Nat. Hist. vol. xxii. p. 332.

1888. *Goniatites* (*Prolecanites*) *tridens*, E. Holzapfel, Abhandl. geol. Specialkarte Preussen &c. vol. viii. pt. 3, p. 29, pl. ii. f. 5 *a*.

1889. *Prolecanites tridens*, E. Holzapfel, Palæont. Abhandl. Dames & Kayser, vol. v. 1, pp. 40, 41.

1889. *Pharciceras tridens*, G. Steinmann & L. Döderlein, Elem. d. Paläont. pt. ii. p. 395, f. 474.

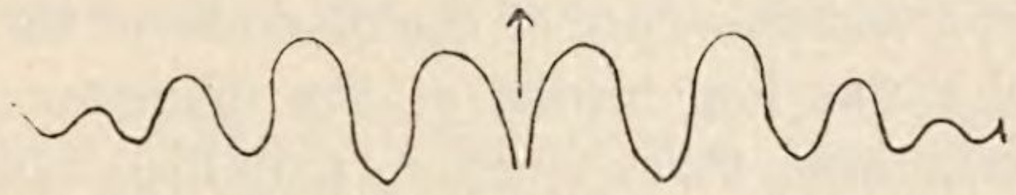
1895. *Prolecanites tridens*, E. Holzapfel, Abhandl. d. k. Preuss. geol. Landesanstalt, n. f. xvi. p. 115.

1895. *Prolecanites tridens*, K. A. v. Zittel, Grundzüge d. Palæont. p. 400.

Sp. Char. Shell discoidal, widely umbilicated; greatest thickness almost close to the inner edge of the whorl, about one-half of the diameter of the shell; height of outer whorl about one-third of the diameter of the shell. Whorls five at least, probably more; inclusion two-thirds; umbilicus about three-sevenths of the diameter in width, rather deep, exposing the edges of all the inner whorls.

Whorl semilunate in section, wider than high; indented to about one-third of its height by the preceding whorl; periphery broadly convex and continuous with the sides; sides inflated, especially near the margin of the umbilicus; inner area narrow, convex, nearly at right angles to the plane of symmetry. Body-chamber (? length). Chambers rather deep; suture-line as in fig. 118. Test

Fig. 118.



Suture-line of *Prolecanites tridens*; natural size.
After Frech.

ornamented with feeble, rather distant close-set growth-folds, which have a tongue-shaped projection near the obscure peripheral band.

Size. Shell attaining a diameter of more than 70 mm.

Form. & Loc. Upper Devonian (Kalk des Cypridinenschiefers): Eibach, Nassau.

C. 5042. Natural mould of an example 27·5 mm. in diameter. The label accompanying this specimen bears the name "F. Odernheimer," and it may be observed that a cast taken from this mould resembles very closely G. & F. Sandberger's pl. iv. f. 2. *Transferred from Mus. Pract. Geol.*

Prolecanites Becheri (L. v. Buch).

1832. *Ammonites Becheri*, Goldfuss, L. v. Buch, Phys. Abhandl. d. k. Akad. d. Wissenschaften Berlin for 1830, p. 171, pl. ii. f. 2.

1837. *Ammonites Becheri*, H. E. Beyrich, De Goniatitis in montibus rhenanis occurrentibus, p. 8, pl. i. ff. 7, 8.

1837. *Ammonites Becheri*, E. Beyrich, Beitr. Kenntn. Verstein. rhein. Uebergangsgeb. p. 31, pl. i. ff. 7, 8.

? 1842. *Goniatites Becheri*, d'Archiac & de Verneuil, Trans. Geol. Soc. [2], vol. vi. p. 382.

1848. *Goniatites Becheri*, H. G. Bronn, Gesch. d. Natur, vol. iii. p. 540.

1850. *Aganides Becheri*, A. d'Orbigny, Prod. de Paléont. stratigr. vol. i. p. 58.

1852. *Ammonites Becheri*, C. G. Giebel, Fauna der Vorwelt, vol. iii. p. 451.

1884. "*Ammonites Becheri*, L. v. Buch," E. Beyrich, Zeitschr. deutsch. geol. Gesell. vol. xxxvi. p. 211.

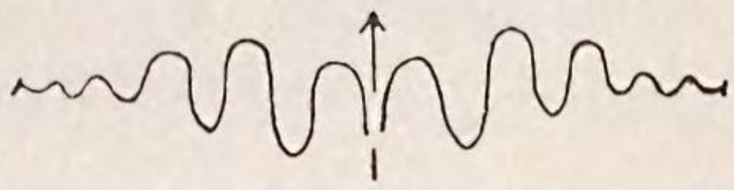
1884. *Prolecanites Becheri*, K. A. Zittel, Handb. d. Palæont. vol. ii. p. 421.

1888. *Goniatites* (*Prolecanites*) *Becheri*, F. Frech, Abhandl. geol. Specialkarte Preussen, &c. vol. viii. pt. 3, p. 28, pl. ii. ff. 4 *a*, 4 *b*, 4 *β*.

1889. *Prolecanites Becheri*, E. Holzapfel, Palæont. Abhandl. Dames & Kayser, vol. v. 1, p. 41.
1889. *Prolecanites Becheri*, G. Steinmann & L. Döderlein, Elem. d. Paläont. pt. ii. p. 395.
1895. *Prolecanites Becheri*, K. A. v. Zittel, Grundzüge d. Palæont. p. 400.

Sp. Char. Shell discoidal, inflated, rather widely umbilicated; greatest thickness at about one-third of the height of the whorl from the suture, about one-third of the diameter of the shell; height of outer whorl about four-ninths of the diameter of the shell. Whorls seven; inclusion three-fourths; umbilicus rather deep, with rounded margin, about one-fourth of the diameter of the shell in width, partly exposing the inner whorls. Whorl subcordate in section, higher than wide; indented to about three-sevenths of its height by the preceding whorl; periphery flattened in the adult, more convex in the immature shell; outer portion of sides flattened, inner portion convex and passing gradually into the inner area; inner area convex, imperfectly defined, sloping towards the umbilicus. Body-chamber (? length). Chambers rather deep; suture-line as in fig. 119.

Fig. 119.



Suture-line of *Prolecanites Becheri*; natural size.
After Frech.

Test ornamented with fine sharp striæ, which form a rather deep sinus on the lateral area, project considerably forward near the peripheral margin, and form a rather deep and wide sinus on the periphery. 'Wrinkle-layer' composed of very fine transverse raised lines.

In the adult the whorls are less inflated and relatively higher than in *Prolec. tridens*; while *Prolec. lunulicosta* is a more evolute shell.

Size. Frech (op. cit. pl. ii. f. 4 *a*) figures an example 90 mm. in diameter.

Form. & Loc. Upper Devonian: Oberscheld, Nassau.

C. 1772. An example, 46 mm. in diameter.
Presented by John Edward Lee, Esq., 1885.

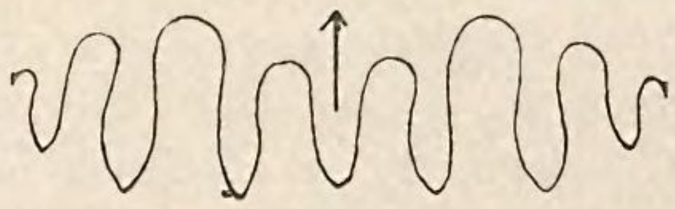
C. 1775. Three fairly well-preserved specimens, 38, 41·5, and 44 mm. in diameter respectively, exhibiting the ornaments of the test, two of them also displaying the 'wrinkle-layer.' *Presented by John Edward Lee, Esq.*, 1885.

Prolecanites ceratitoides (L. v. Buch).

1840. *Goniatites ceratitoides*, L. v. Buch, Phys. Abhandl. d. k. Akad. d. Wissenschaften Berlin for 1838, p. 155, f. 3.
1848. *Goniatites ceratitoides*, H. G. Bronn, Gesch. d. Natur, vol. iii. p. 541.
1850. *Aganides ceratitoides* (pars), A. d'Orbigny, Prod. de Paléont. stratigr. vol. i. p. 115.
1852. *Ammonites ceratitoides*, C. G. Giebel, Fauna der Vorwelt, vol. iii. p. 487.
1881. *Goniatites Henslowi*, C. Barrois, Bol. Com. map. geol. España, vol. viii. p. 9, pl. C. ff. 3 *a*, *b*, *c*.
1882. *Goniatites Henslowi*, C. Barrois, Mém. Soc. géol. du Nord, vol. ii. p. 294, pl. xiv. ff. 3 *a–d*.
1882. *Prolecanites ceratitoides*, E. v. Mojsisovics, Abhandl. d. k.-k. geol. Reichsanst. vol. x. p. 199.
1884. "*Goniatites ceratitoides*, L. v. Buch," E. Beyrich, Zeitschr. deutsch. geol. Gesell. vol. xxxvi. p. 218.
1889. *Prolecanites ceratitoides*, E. Holzapfel, Abhandl. Palæont. Dames & Kayser, vol. v. 1, p. 43, pl. iii. f. 13; pl. iv. ff. 1, 3, 6; pl. v.

Sp. Char. Shell discoidal, slowly increasing, very flat, evolute, widely umbilicated; greatest thickness almost close to the umbilical margin, about one-eighth of the diameter of the shell; height of outer whorl nearly one-fourth of the diameter of the shell. Whorls at least five or six; inclusion almost nil; umbilicus wide, shallow, with sloping sides and subangular margin. Whorl almost rectangular in section, higher than wide; very slightly indented by the preceding whorl; periphery flattened, feebly convex; sides flattened, almost parallel, very slightly convex; inner area feebly convex, sloping towards the umbilicus. Body-chamber long, occupying more than a whorl. Chambers rather shallow; suture-line as in fig. 120. Test almost smooth, rarely with feeble falciform lines of growth.

Fig. 120.



Suture-line of *Prolecanites ceratitoides*; natural size.
After Holzapfel.

This shell increases less rapidly than *Prolecanites compressus*, and the peripheral lobe of its suture-line is expanded posteriorly and not infundibuliform as in that species.

Size. Holzapfel (op. cit. pl. v.) figures an example 180 mm. in diameter.

Form. & Loc. Carboniferous : Asturias, Spain.

37491 a. Imperfect entirely septate example, 30 mm. in diameter.
Presented by S. P. Pratt, Esq., 1858.

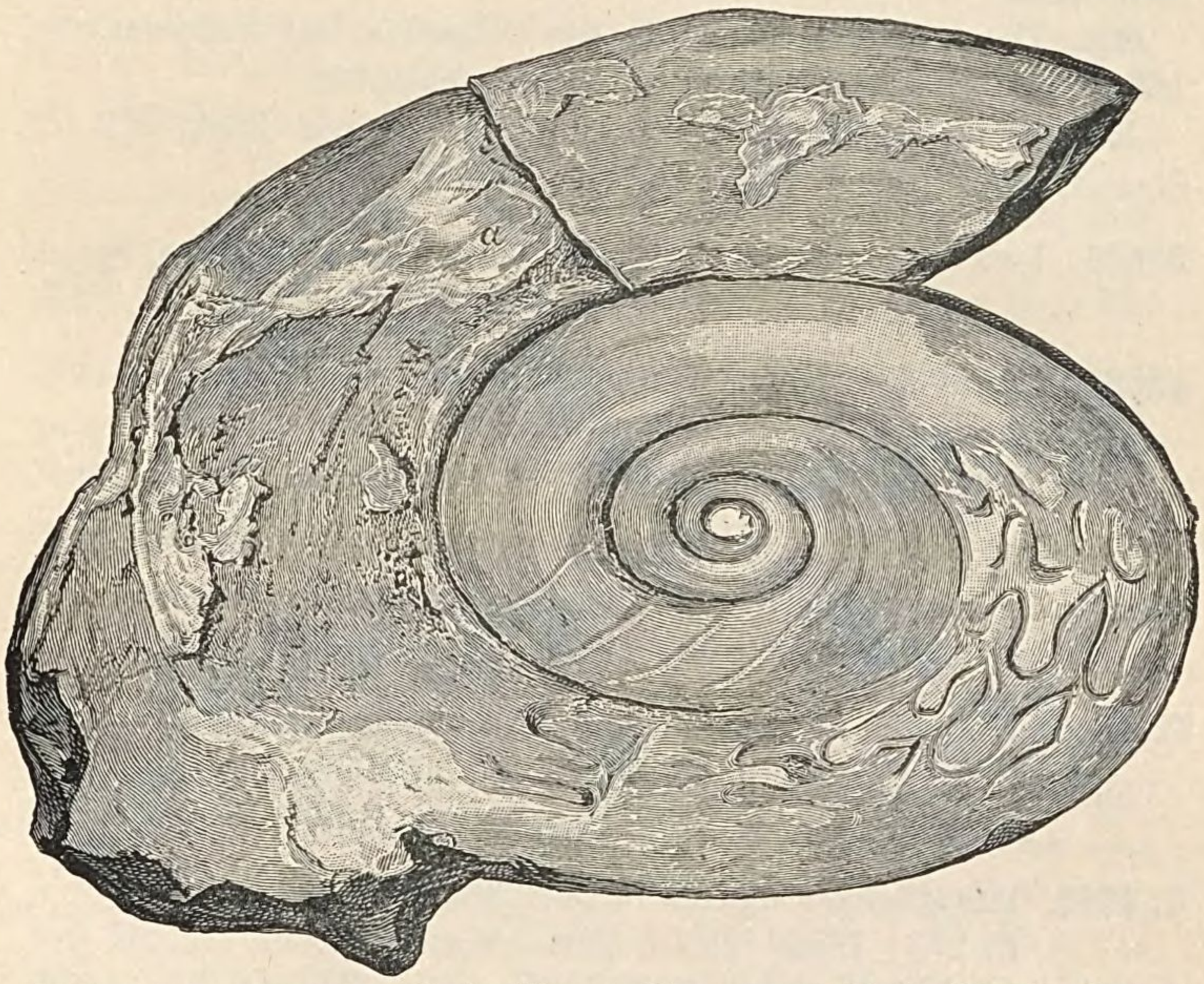
Prolecanites compressus (J. Sowerby).

[Fig. 116 *a*, *b*, *c*, p. 245 ; fig. 121.]

1813. *Ellipsolites compressus*, J. Sowerby, Min. Con. vol. i. p. 84, pl. xxxviii.
1820. *Ammonites Henslowi*, J. Sowerby, ibid. vol. iii. p. 111, pl. cclxii.
1822. *Ammonellipsites compressus*, J. Parkinson, Introd. Foss. Org. Rem. pp. 164 & 233.
1825. *Ceratites Henslowi*, de Haan, Monog. Ammon. et Goniat. p. 157.
1825. *Planites compressus*, de Haan, ibid. p. 93.
1828. *Nautilus compressus*, J. Fleming, Hist. Brit. Anim. p. 231.
1828. *Ammonites Henslowi*, J. Fleming, ibid. p. 240.
1832. *Ammonites Henslowi*, L. v. Buch, Phys. Abhandl. d. k. Akad. Wissenschaften Berlin for 1830, p. 171, pl. ii. f. 1.
1836. *Goniatites Henslowi*, J. Phillips, Geol. Yorks. pt. ii. p. 236, pl. xx. f. 39.
1842. *Goniatites Henslowi*, d'Archiac & de Verneuil, Trans. Geol. Soc. [2], vol. vi. 1842, p. 329.
1843. *Goniatites Henslowi*, J. Morris, Cat. Brit. Foss. p. 179.
1843. *Nautilus compressus*, J. Morris, ibid. p. 182.
1848. *Goniatites Henslowii*, J. G. Cumming, Isle of Man, p. 127.
1848. *Goniatites Henslowi*, H. G. Bronn, Gesch. d. Natur, vol. iii. p. 542.
1848. *Goniatites spurius* (pars), H. G. Bronn, Gesch. d. Natur, vol. iii. p. 545.
1850. *Aganides Henslowi*, A. d'Orbigny, Prod. de Paléont. stratigr. vol. i. p. 115.
1850. *Nautilus compressus*, A. d'Orbigny, ibid. vol. i. p. 110.
1852. *Ammonites Henslowi*, C. G. Giebel, Fauna der Vorwelt, vol. iii. p. 451.
1852. *Nautilus compressus*, C. G. Giebel, ibid. p. 178.
1854. *Goniatites Henslowi*, J. Morris, Cat. Brit. Foss. 2nd ed. p. 303.
1854. *Nautilus* (*Discites*) *compressus*, J. Morris, ibid. p. 308.
1855. *Aganides Henslowi*, F. M'Coy, Brit. Pal. Foss. p. 564.
1882. *Prolecanites Henslowi*, E. v. Mojsisovics, Abhandl. d. k.-k. geol. Reichsanst. vol. x. p. 199.
1884. *Prolecanites Henslowi*, K. A. Zittel, Handb. d. Palæont. vol. ii. p. 421.
1884. "*Ammonites Henslowi*, L. v. Buch," E. Beyrich, Zeitschr. deutsch. geol. Gesell. vol. xxxvi. p. 210.
1888. *Goniatites Henslowi*, R. Etheridge, Brit. Foss. vol. i., Palæozoic, p. 311.

1888. *Discites compressus*, R. Etheridge, ibid. vol. i., Palæozoic, p. 310.
1889. *Prolecanites Henslowi*, E. Holzapfel, Palæont. Abhandl. Dames & Kayser, vol. v. 1, p. 42, pl. iii. f. 14; pl. iv. ff. 2, 4, 7.
1891. *Discites compressus* (pars), A. H. Foord, Cat. Foss. Ceph. Brit. Mus. pt. ii. p. 91.
1892. *Goniatites* (*Prolecanites*) *Henslowi*, J. Seunes, Comptes Rendus, vol. cxv. p. 681.
1894. *Prolecanites compressus*, A. H. Foord & G. C. Crick, Geol. Mag. [4], vol. i. p. 11, pl. i.
1895. *Prolecanites Henslowi*, K. A. v. Zittel, Grundzüge d. Palæont. p. 400.

Fig. 121.



Prolecanites compressus.—Carboniferous Limestone; Little Island, Queentown Harbour, Ireland. Drawn from a specimen in the British Museum Collection. One half of the natural size.

Sp. Char. Shell discoidal, compressed, evolute, widely umbilicated; greatest thickness at about the middle of the lateral area, about one-fourth of the diameter of the shell; height of outer whorl rather more than one-third of the diameter of the shell. Whorls seven or eight; inclusion almost nil; umbilicus shallow, about two-fifths of the diameter of the shell in width. Whorl subtrapezoidal in section, higher than wide; scarcely indented by the preceding whorl; periphery flattened, feebly convex in the middle, but slightly concave near each margin, with prominent subangular margins; sides

flattened, feebly convex, becoming more inflated on the body-chamber; inner area fairly well-defined, slightly convex, sloping towards the umbilicus. Body-chamber occupying at least half of a whorl. Chambers rather shallow, fourteen or fifteen in a whorl; suture-line as in fig. 116 *c* (p. 245). Test thin, nearly smooth, with obscure lines of growth, which form a shallow sinus on the lateral area and a broad shallow sinus on the periphery.

This is the well-known "*Ammonites Henslowi*" of Sowerby, which has been shown[1] to be identical with the species that the same author described some years previously as "*Ellipsolites compressus.*"

Size. The largest specimen in the Collection has a diameter of 168 mm., and lacks a portion of the body-chamber.

Form. & Loc. Carboniferous Limestone: Black Rock, S.E. of Cork, Ireland; Isle of Man; Asturias, Spain.

37491. Two fragments exhibiting the suture-line: Asturias, Spain.
Presented by S. P. Pratt, Esq., 1858.

43867. The two specimens figured by Sowerby as *Ellipsolites compressus*. They are both elliptical, their diameters being 115 and 84, and 53 and 34 respectively. Black Rock, S.E. of Cork, Ireland. *Sowerby Coll.*

43872. A fairly well-preserved specimen, 168 mm. in diameter, not distorted, in matrix; (? Isle of Man). *Sowerby Coll.*

C. 3496. Example in matrix figured in Trans. Manchester Geol. Soc. vol. xxiii. p. 86; Scarlet, I. of Man.
Presented by Miss C. Birley, 1891.

C. 4630. The specimen figured in Geol. Mag. [4], vol. i. 1894, pl. i. ff. 1–5; Little Island, Queenstown Harbour, Ireland (see fig. 121, p. 253). *Presented by Joseph Wright, Esq.*, 1893.

Prolecanites mixolobus (J. Phillips).

[Fig. 116 *d*, *e*, p. 245.]

1836. *Goniatites mixolobus*, J. Phillips, Geol. Yorks. pt. ii. p. 236, pl. xx. f. 43 (? 44); *not* ff. 45–47.

1841. *Goniatites mixolobus*, J. Phillips, Pal. Foss. Cornwall, Devon, and West Somerset (Mem. Geol. Surv.), p. 122, pl. li. f. 235 *b*, *c* (? *d*, *e*) [2].

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[1] Geol. Mag. [4], vol. i. 1894, pp. 11–17.

[2] Karpinsky names the figures 235 *a*, *f*, *g*, *Pronorites Phillipsi* (Mém. Acad Imp. Sci. St. Pétersbourg, [7], vol. xxxvii. no. 2, 1889, p. 4).

1843. *Goniatites mixolobus* (pars), J. Morris, Cat. Brit. Foss. p. 180.
1848. *Goniatites mixolobus* (pars), H. G. Bronn, Gesch. d. Natur, vol. iii. p. 543.
1850. *Aganides mixolobus* (pars), A. d'Orbigny, Prod. de Paléont. stratigr. vol. i. p. 115.
1850–56. *Goniatites mixolobus*, G. & F. Sandberger, Verst. rhein. Schichtensyst. Nassau, p. 67, pl. iii. ff. 13, 13 *a*, *b* (*not* pl. ix. ff. 6, 6 *a*).
1852. *Ammonites mixolobus* (pars), C. G. Giebel, Fauna der Vorwelt, vol. iii. p. 410.
1854. *Goniatites mixolobus* (pars), J. Morris, Cat. Brit. Foss. 2nd ed. p. 304.
1878. *Gonatites mixolobus*, J. J. Bigsby, Thesaur. devon.-carb. p. 339.
? 1880. *Goniatites mixolobus*, L. G. de Koninck, Faune Calc. Carb. de la Belgique (Ann. Mus. Roy. d'Hist. nat. de Belgique, sér. Paléont. vol. v.), pt. ii. p. 122, pl. l. f. 15 (*not* the suture-line on p. 122).
1882. *Prolecanites mixolobus*, E. v. Mojsisovics, Abhandl. d. k.-k. geol. Reichsanst. vol. x. p. 199.
1884. *Pronorites mixolobus* (pars), A. Hyatt, Proc. Boston Soc. Nat. Hist. vol. xxii. p. 337.
1884. *Pronorites mixolobus*, K. A. Zittel, Handb. d. Palæont. vol. ii. p. 421.
1888. *Goniatites mixolobus* (pars), R. Etheridge, Brit. Foss. vol. i. Palæozoic, p. 312.
1889. *Pronorites mixolobus*, G. Steinmann & L. Döderlein, Elem. d. Paläont. pt. ii. p. 395.
1895. *Goniatites* [*Prolecanites*] *mixolobus*, G. C. Crick, Quart. Journ. Geol. Soc. vol. li. p. 652.

Sp. Char. Shell rather small, discoidal, compressed, evolute; greatest thickness at a short distance from the edge of the umbilicus (? about one-fourth of the diameter of the shell); height of outer whorl nearly one-third of the diameter of the shell. Whorls six or seven; inclusion almost nil; umbilicus about three-sevenths of the diameter of the shell in width, shallow, exposing the inner whorls. Whorl oval in section, a little higher than wide; scarcely indented by the preceding whorl; periphery convex; sides flattened, feebly convex, passing imperceptibly into the inner area which slopes towards the umbilicus. Body-chamber (? length). Chambers shallow; suture-line as in fig. 116 *e* (p. 245). Test almost perfectly smooth, merely with very obscure, fine lines of growth. Initial-chamber small.

The above diagnosis has been drawn up from Phillips's type, which besides being very imperfect is also imbedded in matrix. The external lobe appears to have terminated in a single point, the first lateral lobe certainly does. We have therefore excluded from

this species Phillips's figures 45–47, in which the external and first lateral lobes are depicted as trifid and bifid respectively.

Size. Phillips's type has a diameter of 19 mm. and is entirely septate.

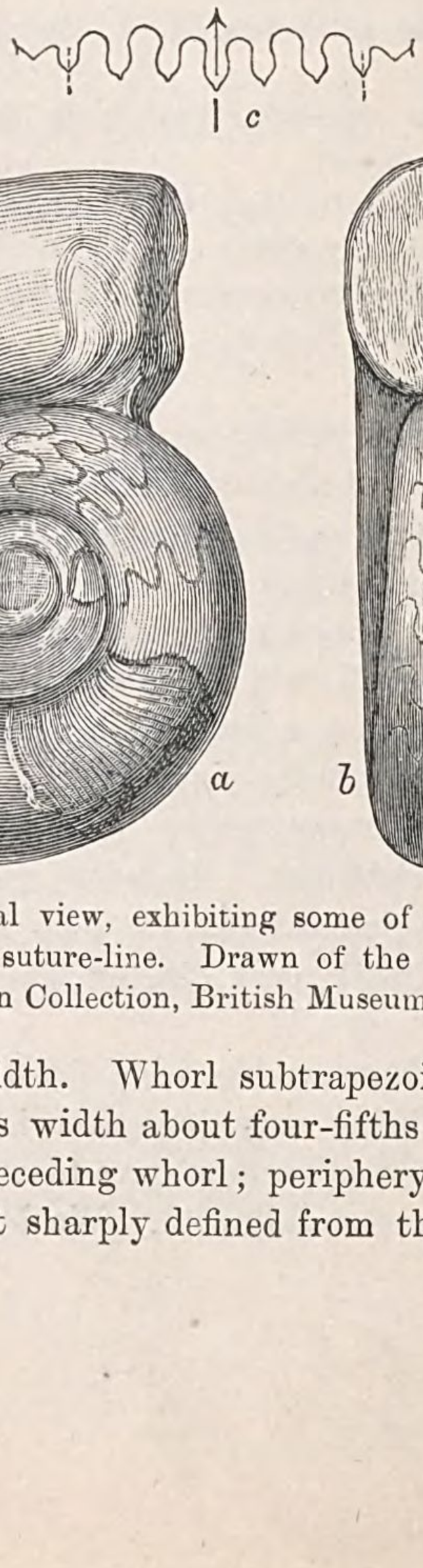
Form. & Loc. Carboniferous Limestone: Bolland.

C. 281 a. The type specimen, figured *loc. cit.* *Gilbertson Coll.*

Prolecanites discoides, sp. nov.

Sp. Char. Shell discoidal, slowly increasing, evolute, widely umbilicated; greatest thickness at about one-third of the height of the whorl from its inner edge, about two-sevenths of the diameter of the shell; height of outer whorl about one-third of the diameter of the shell. Whorls five or six; inclusion almost nil, the whorls merely in contact; umbilicus shallow, about three-eighths of the

Fig. 122.



Prolecanites discoides.—*a*, lateral view, exhibiting some of the ornaments of the test; *b*, front view; *c*, suture-line. Drawn of the natural size from a specimen in the Gilbertson Collection, British Museum.

diameter of the shell in width. Whorl subtrapezoidal in section, the sides nearly parallel, its width about four-fifths of the height; scarcely indented by the preceding whorl; periphery convex; sides almost flat; inner area not sharply defined from the side, convex,

rather wide, sloping towards the umbilicus. Body-chamber occupying rather more than one-half of a whorl. Chambers shallow; suture-line as in fig. 122 *c*. Test almost smooth, merely with very fine lines of growth, which are slightly waved on the side and form a shallow forwardly-concave sinus on the periphery.

The above description is based chiefly upon the larger of the specimens in the Collection bearing the number C. 231. The species may possibly be de Koninck's *Gon. clymeniæformis* [1], a name, however, which was preoccupied by Münster [2].

It comes very near *P. ceratitoides* (v. Buch [3]), but is a more rapidly increasing shell; the same character and the form of the suture-line (as given by M'Coy) distinguish it from *P. discus* (M'Coy) [4].

Size. The largest specimen in the Collection is 56 mm. in diameter.

Form. & Loc. Carboniferous Limestone: probably Yorkshire.

C. 231. Two well-preserved examples, 29 and 56 mm. in diameter respectively. The other dimensions of the larger specimen are:—greatest thickness, 16·5 mm.; width of umbilicus, 22·5 mm.; height of outer whorl, 19·5 mm.; ditto above preceding whorl, 19·5 mm.; approximate width of periphery, 13·0 mm. *Gilbertson Coll.*

Prolecanites serpentinus (J. Phillips).

1836. *Goniatites serpentinus*, J. Phillips, Geol. Yorks. pt. ii. p. 237, pl. xx. ff. 48–50.

? 1841. *Goniatites serpentinus*, J. Phillips, Pal. Foss. Cornwall, Devon, and West Somerset (Mem. Geol. Surv.), p. 123, pl. li. f. 237.

1842–44. *Ammonites ophideus*, L. G. de Koninck, Descr. Anim. Foss. p. 564, pl. l. f. 6.

1843. *Goniatites serpentinus*, J. Morris, Cat. Brit. Foss. p. 180.

1848. *Goniatites serpentinus*, H. G. Bronn, Gesch. d. Natur, vol. iii. p. 544.

1850. *Ayanides ceratitoides* (pars), A. d'Orbigny, Prod. de Paléont. stratigr. vol. i. p. 115.

1852. *Ammonites ophideus*, C. G. Giebel, Fauna der Vorwelt, vol. iii. p. 409.

1854. *Goniatites serpentinus*, J. Morris, Cat. Brit. Foss. 2nd ed. p. 304.

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[1] L. G. de Koninck, Faune du Calc. Carb. de la Belgique (Ann. Mus. Roy. d'Hist. nat. de Belgique, sér. Paléont. vol. v.), pt. ii. 1880, p. 95, pl. xlix. ff. 12, 13.

[2] G. Münster, Beiträge zur Petrefactenkunde, i. 1839, p. 24, pl. xvii. f. 4.

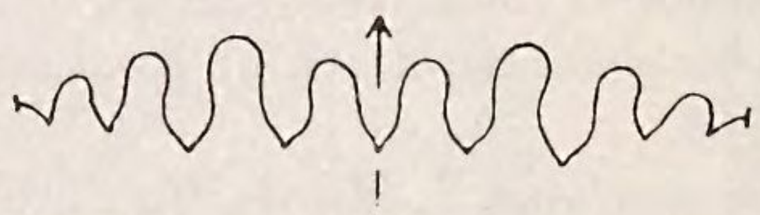
[3] L. v. Buch, "Ueber Goniatiten und Clymenien in Schlesien," Phys. Abh. d. k. Akad. d. Wissenschaften Berlin for 1838, p. 155, f. 3 (1840).

[4] F. M'Coy, Synop. Carb. Limest. Foss. Ireland, 1844, p. 13, pl. ii. f. 6.

1855-57. *Goniatites serpentinus*, J. Kelly, Journ. Geol. Soc. Dublin, vol. vii. p. 7.
1878. *Goniatites serpentinus*, J. J. Bigsby, Thesaurus dev.-carb. p. 339.
1880. *Goniatites serpentinus*, L. G. de Koninck, Faune Calc. Carb. de la Belgique (Ann. Mus. Roy. d'Hist. nat. de Belgique, sér. Paléont. vol. v.), pt. ii. p. 96, pl. l. f. 14.
1882. *Prolecanites serpentinus*, E. v. Mojsisovics, Abhandl. d. k.-k. geol. Reichsanst. vol. x. p. 199.
1884. *Prolecanites serpentinus*, K. A. Zittel, Handb. d. Palæont. vol. ii. p. 421.
1888. *Goniatites serpentinus*, R. Etheridge, Brit. Foss. vol. i., Palæozoic, p. 312.
1889. *Prolecanites serpentinus*, E. Holzapfel, Palæont. Abhandl. Dames & Kayser, vol. v. 1, p. 41.

Sp. Char. Shell rather small, discoidal, compressed, evolute; greatest thickness at a short distance from the inner edge of the whorl, a little more than two-sevenths of the diameter of the shell; height of outer whorl about three-eighths of the diameter of the shell. Whorls four or five; inclusion almost nil; umbilicus shallow, nearly three-sevenths of the diameter of the shell in width. Whorl subquadrate in section, a little higher than wide; scarcely indented by the preceding whorl; periphery convex; sides feebly convex, somewhat flattened; inner area imperfectly defined, continuous with the sides, sloping towards the umbilicus. Body-chamber occupying at least half a whorl; chambers rather shallow, suture-line as in fig. 123. Test almost smooth, with obscure lines of growth,

Fig. 123.



Suture-line of *Prolecanites serpentinus*. Drawn of twice the natural size from a specimen in the Collection.

which are directed backward on the sides of the whorls and form a rather wide sinus on the periphery.

Phillips's type is entirely septate. The largest example of the species in the Collection has rounded lobes on the inner whorls as in Phillips's type, but these are decidedly pointed on the outer whorl. This shell increases more rapidly and has a relatively narrower umbilicus than *Prolec. mixolobus*.

Size. The largest example in the Collection is part of a specimen 21 mm. in diameter; it is almost entirely septate.

Form. & Loc. Carboniferous Limestone: Bolland, Yorkshire; Visé, Belgium (Calcaire de Visé—Assise VI.).

39812. A small slab containing the greater part of a specimen 21 mm. in diameter; the suture-line on the inner whorls has rounded lobes, but these are pointed in the outer whorl (see fig. 123). On the same slab are *Glyphioceras crenistria*, *Nomismoceras spirorbis* and *Nom. rotiforme*. Black Hall, Bolland. *Presented by John Rofe, Esq.*, 1862.

97368 a. Two examples, each about 14 mm. in diameter, in matrix, one somewhat imperfect, but showing the initial-chamber; locality not recorded.
Presented on behalf of the late Mr. John Rofe, 1878.

C. 265. Phillips's type-specimen (marked *a*), 12·5 mm. in diameter; and a portion of the whorl of another specimen, about 14 mm. in diameter, exhibiting the suture-line; Black Hall, Bolland. *Gilbertson Coll.*

C. 270 b, C. 281 b. Two specimens, 9 and 10 mm. in diameter respectively, the larger very imperfect but displaying the ornaments of the test and the initial-chamber; Black Hall, Bolland. *Gilbertson Coll.*

64847. Distorted entirely septate specimen, 17·5 mm. in diameter, labelled "*Goniatites ophideus*" in de Koninck's handwriting; Visé, Belgium. *Purchased*, 1868.

Prolecanites similis, G. C. Crick.

1895. *Prolecanites similis*, G. C. Crick, Trans. Manchester Geol. Soc. vol. xxiii. pt. 3, p. 80; woodc. p. 87.

Sp. Char. Shell rather large, discoidal, evolute, much flattened; greatest thickness at a short distance from the edge of the umbilicus, about one-eighth of the diameter of the shell; height of outer whorl about three-tenths of the diameter of the shell. Whorls six or seven; evolute, merely in contact; umbilicus about one-half of the diameter of the shell in width, very shallow. Whorl subquadrate in section, much higher than wide; periphery narrowly rounded (in the cast); sides very slightly convex, nearly flat, almost parallel to each other; inner area sloping towards the umbilicus, feebly convex. Body-chamber occupying at least a quarter of a whorl, aperture not seen. Chambers rather shallow, about twenty-one in a whorl; suture-line as in fig. 124. Test apparently smooth.

This species is most nearly allied to *Prolecanites ceratitoides*, but the suture-line of the latter differs somewhat from that of *P. similis*, principally as regards the form of the outer (external or peripheral)

lobe, as well as the shape of that portion of the suture-line which is situated upon the inner area of the whorl. Compared with *Prolecanites compressus*, *P. similis* is a less rapidly increasing shell, and its suture-line lacks the angular lobe conspicuous on the inner area of the whorl of that species.

Fig. 124.

Suture-line of *Prolecanites similis*. Drawn from the type-specimen and reduced one half.

Size. The type has the following dimensions:—Diameter of shell, 162 mm.; width of umbilicus, 77·5 mm.; height of outer whorl, 48·5; thickness of outer whorl estimated at about 20 mm.

Form. & Loc. Carboniferous Limestone: Haw Bank Tunnel, Skipton, Yorkshire.

C. 5029. Plaster cast of type-specimen. *Made in the Museum.*

The following specimens are probably referable to *Prolecanites*:—

C. 1958. Impression of portion of an elliptical example on surface of small slab. Upper Devonian: Lower Dunscombe, near Chudleigh, S. Devon.

Presented by John Edward Lee, Esq., 1885.

C. 2120. Small slab bearing impression of elliptical example whose greater diameter is 22 mm. Culm: "Railway-cutting, 1 mile west." Probably from Devon.

Presented by John Edward Lee, Esq., 1885.

Genus **PRONORITES,** E. v. Mojsisovics[1].

Syn. *Goniatites*, Phillips, 1836[2] (pars), et auct.; *Aganides*, d'Orbigny, 1850[3] (pars); *Ammonites*, C. G. Giebel, 1852[4] (pars).

Type. *Goniatites cyclolobus* (Phillips), C. Barrois, Bol. Com. Map. geol. España, vol. viii. p. 8, pl. C. ff. 2 *a–c* (1881)[5].

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[1] Abhandl. d. k.-k. geol. Reichsanst. vol. x. 1882, p. 201.

[2] Geology of Yorkshire, pt. ii. p. 237.

[3] Prod. de Paléont. stratigr. vol. i. p. 115.

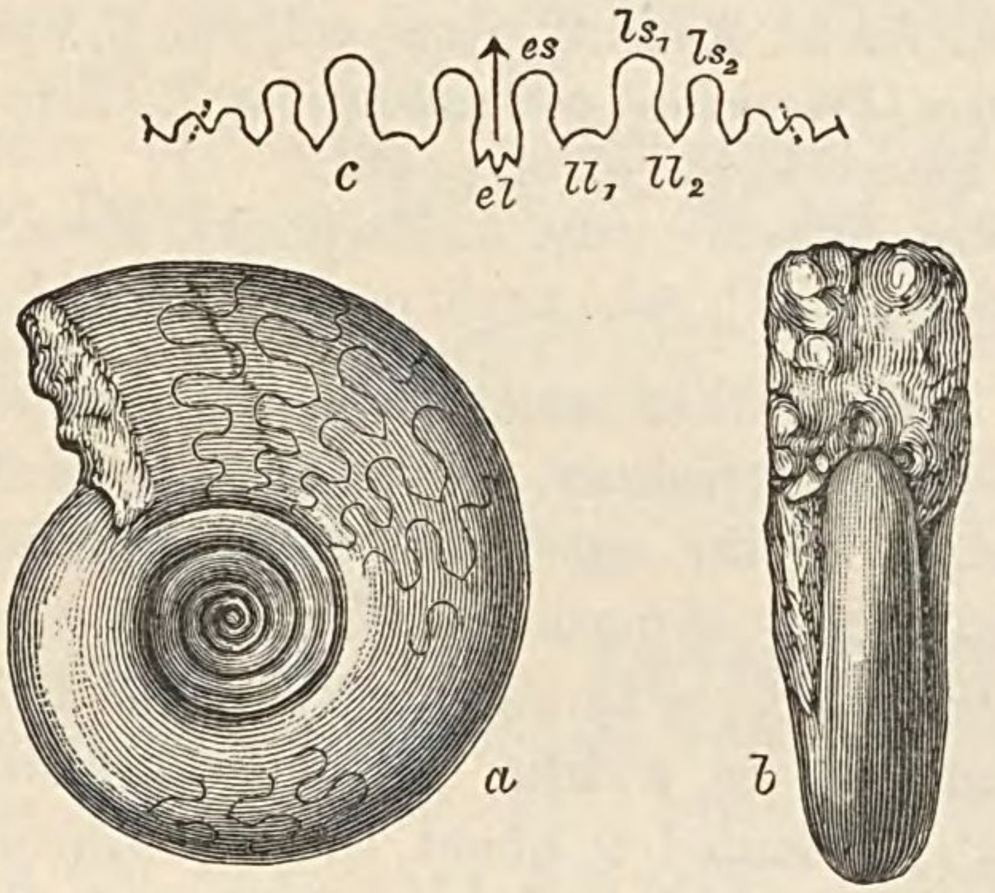
[4] Fauna der Vorwelt, vol. iii. p. 410.

[5] Although not expressly stated to be the type, this is the first species mentioned by Mojsisovics as belonging to this genus.

Shell discoidal, smooth, umbilicated, with rounded or flattened periphery, sometimes with feeble keel. External (outer or peripheral) lobe trifid; first lateral lobe bifid, the rest with a single point.

Carboniferous and Permo-Carboniferous.

Fig. 125.



Pronorites cyclolobus.—*a*, lateral view: *b*, front view: *c*, suture-line—*el*, external, outer or peripheral lobe; *es*, external, outer or peripheral saddle; ll_1, first lateral lobe; ls_1, first lateral saddle; ll_2, second lateral lobe; ls_2, second lateral saddle. Drawn of the natural size from Philips's type-specimen in the Gilbertson Collection, British Museum.

Remarks.—Mojsisovics considered *Pronorites* to be related to the Triassic genus *Norites*, but Hyatt does not admit their genetic connection, "since the affinities between these two forms are due to larval stages of the sutures, which are equally characteristic of *Carnites*, and some other genera." Hyatt says: "The form of whorl of *Norites* and the outlines of the sutures appear to us, as to Griesbach, to be closer to those of *Sageceras*. *Norites* is not very remote from *Longobardites*, which in our opinion is in the young similar to the genus *Prolecanites* both in form of whorls, and in modes of generating lobes and saddles. It seems to us possible that the derivation of the group may have been from the lower forms of the Prolecanitidæ, but not from *Pronorites*."

The aspect of the suture-line of *Pronorites* shows that this genus belongs to the Prolecanitidæ. *Pronorites* differs from *Prolecanites* in the form of the peripheral and first lateral lobes. In *Pronorites* the peripheral lobe is trifid, the first lateral lobe is usually bifid, but sometimes has an additional smaller indentation, and the rest of the lobes terminate in a single obtuse point; whilst in *Prolecanites* each lobe terminates in a single point.

Pronorites postcarbonarius (A. Karpinsky).

1874. *Goniatites postcarbonarius*, A. Karpinsky, Verhandl. Russ.-Kaiserl. Mineral. Gesell. St. Petersburg, [2], vol. ix. p. 291, pl. xii. ff. 6–8.

1882. *Pronorites postcarbonarius*, E. v. Mojsisovics, Abhandl. d. k.-k. geol. Reichsanst. vol. x. p. 201.

1885. *Goniatites* (*Pronorites*) *postcarbonarius*, P. Krotow, Trudui Obshchest. Estest. Kazansk. Unīv. vol. xiii. p. 203, pl. i. ff. 22–24.

1888. *Goniatites* (*Pronorites*) *postcarbonarius*, P. Krotow, Mém. Com. géol. St. Pétersbourg, vol. vi. p. 474.

1889. *Pronorites postcarbonarius*, A. Karpinsky, Mém. Acad. Imp. Sci. St. Pétersbourg, [7], vol. xxxvii. no. 2, p. 13, pl. i. ff. 3 *a–d*.

Sp. Char. Shell rather small, discoidal, involute; greatest thickness close to the periphery, about one-half of the diameter of the shell; height of the outer whorl about two-ninths of the diameter of the shell. Whorls few (? number); inclusion three-fourths; umbilicus deep, with steep sides, about two-ninths of the diameter of the shell in width. Whorl subquadrate in section, wider than high; indented to about two-sevenths of its height by the preceding whorl; periphery broad, about one-half of the diameter of the shell in width, flattened (var. *tetragonus*), or feebly convex (var. *vulgaris*), with subangular margins; sides flat, or even a little concave, almost parallel, slightly divergent; inner area well-defined, narrow, feebly convex, nearly at right angles to the plane of symmetry. Body-chamber occupying three-fourths of a whorl.

Fig. 126.

Suture-line of *Pronorites postcarbonarius*; somewhat enlarged.
After Karpinsky.

Chambers moderately shallow; suture-line as in fig. 126. Test thin, with obscure lines of growth, which are slightly convex on the sides and form a broad, very shallow sinus on the periphery.

This species differs from all the other known species of *Pronorites* by the form of the cross-section of its whorls, which in all stages of growth are wider than high.

Size. Shell attaining a diameter of 18 mm.

Form. & Loc. Artinsk Stufe (Permo-Carboniferous): River Silwa, Perm, Russia.

C. 1502. Six specimens, ranging in diameter from 13 to 18 mm.; some imperfect and in matrix. *Purchased*, 1886.

Pronorites praepermicus (A. Karpinsky).

1874. *Goniatites praepermicus*, A. Karpinsky, Verhandl. Russ.-Kaiserl. Mineral. Gesell. St. Petersburg, [2], vol. ix. p. 293, woodc. 1, 2, & 3, pl. xii. ff. 15–17.

1882. *Pronorites praepermicus*, E. v. Mojsisovics, Abhandl. d. k.-k. geol. Reichsanst. vol. x. p. 201.

1883. *Pronorites sp. indet.*, A. Karpinsky, Verhandl. Russ.-Kaiserl. Mineral. Gesell. vol. xviii. p. 216.

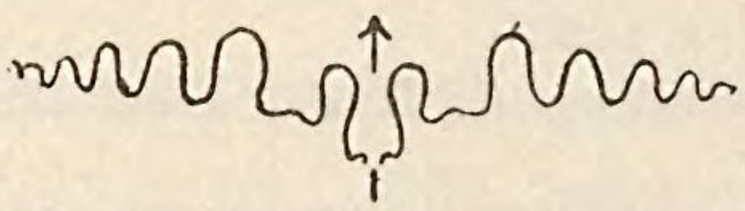
1885. *Goniatites* (*Pronorites*) *praepermicus*, P. Krotow, Trudui Obshchest. Estest. Kazansk. Unīv. vol. xiii. pt. 5, p. 201, pl. i. ff. 16–21.

1888. *Goniatites* (*Pronorites*) *praepermicus*, P. Krotow, Mém. Com. Géol. St. Pétersbourg, vol. vi. p. 473.

1889. *Pronorites praepermicus*, A. Karpinsky, Mém. Acad. Imp. Sci. St. Pétersbourg, [7], vol. xxxvii. no. 2, p. 11, pl. i. ff. 2 *a–n*.

Sp. Char. Shell rather small, discoidal, involute, somewhat rapidly increasing; greatest thickness near the periphery, about two-fifths of the diameter of the shell; height of outer whorl nearly four-sevenths of the diameter of the shell. Whorls (? number); inclusion almost complete in the adult, less in the young; umbilicus about one-tenth of the diameter of the shell in width, deep, with steep sides. Whorl quadrate in section, higher than wide; indented to about three-eighths of its height by the preceding whorl; periphery feebly convex, flattened, nearly one-third of the corresponding diameter of the shell in width, with obtusely angular margins and a very fine longitudinal median raised line on the inner side of the shell producing a fine groove on internal casts; sides flat, slightly divergent; inner area narrow, fairly well-defined, feebly convex, almost at right angles to the plane of symmetry. Body-chamber occupying three-fourths of a whorl. Chambers very shallow; suture-line as in fig. 127. Test thin, apparently smooth. Initial-chamber transversely ellipsoidal.

Fig. 127.



Suture-line of *Pronorites praepermicus*.
After Karpinsky.

Size. Karpinsky (*op. cit.* woodc. p. 293) figures a portion of a specimen which when complete was probably 44 mm. in diameter.

Form. & Loc. Artinsk Stufe (Permo-Carboniferous): River Koswa, Perm, Russia.

C. 1501. Eight specimens, ranging in diameter from 12·5 to 29 mm.
Purchased, 1886.

Pronorites cyclolobus (J. Phillips).

(See fig. 125, *suprà* p. 261.)

1836. *Goniatites cyclolobus*, J. Phillips, Geol. Yorks. pt. ii. p. 237, pl. xx. ff. 40–42.
1843. *Goniatites cyclolobus*, J. Morris, Cat. Brit. Foss. p. 179.
1845. *Goniatites cyclolobus*, E. de Verneuil, in Murchison, de Verneuil, & de Keyserling, Géol. Russie d'Europe, &c. vol. ii. p. 370, pl. xxvii. f. 4.
1848. *Goniatites cyclolobus*, H. G. Bronn, Gesch. d. Natur, vol. iii. p. 541.
1850. *Aganides cyclolobus*, A. d'Orbigny, Prod. de Paléont. stratigr. vol. i. p. 115.
1852. *Ammonites cyclolobus*, C. G. Giebel, Fauna der Vorwelt, vol. iii. p. 410.
1854. *Goniatites cyclolobus*, Cat. Brit. Foss. 2nd ed. p. 303.
1860. *Goniatites cyclolobus*, F. A. Roemer, Beitr. geol. Kenntn. nordwestl. Harzgeb. pt. iv. p. 167, pl. xxvii. f. 1 (*not* pt. ii. p. 95, pl. xiii. f. 34).
1862–64. *Goniatites cyclolobus*, F. A. Roemer, Palæontogr. vol. ix. p. 11, pl. iv. ff. 1 *a*, *b*, *c*.
1878. *Goniatites cyclolobus*, J. J. Bigsby, Thesaur. dev.-carb. p. 337.
1880. *Goniatites cyclolobus*, L. G. de Koninck, Faune Calc. Carb. de la Belgique (Ann. Mus. Roy. d'Hist. nat. de Belgique, sér. Paléont. vol. v.), pt. ii. p. 121, pl. l. ff. 5, 6.
1881. *Goniatites cyclolobus*, C. Barrois, Bol. Com. Map. geol. España, vol. viii. p. 8, pl. C. ff. 2 *a–c* [1].
1882. *Goniatites cyclolobus*, C. Barrois, Mém. Soc. géol. du Nord, vol. ii. p. 295, pl. xiv. ff. 2 *a–c*.
1882. *Pronorites cyclolobus*, E. v. Mojsisovics, Abhandl. d. k.-k. geol. Reichsanst. vol. x. p. 201.
1884. *Pronorites cyclolobus*, A. Hyatt, Proc. Boston Soc. Nat. Hist. vol. xxii. p. 337.
1884. *Pronorites cyclolobus*, K. A. Zittel, Handb. d. Palæont. vol. ii. p. 421, f. 580.
1888. *Goniatites cyclolobus*, R. Etheridge, Brit. Foss. vol. i., Palæozoic, p. 311.
1889. *Pronorites cyclolobus*, G. Steinmann & L. Döderlein, Elem. d. Paläont. pt. ii. p. 395, f. 475.
1895. *Pronorites cyclolobus*, K. A. v. Zittel, Grundzüge d. Palæont. p. 400, f. 1089.

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[1] This paper itself is dated 1879.

Sp. Char. Shell of medium size, discoidal, much compressed; greatest thickness near the periphery, about two-sevenths of the diameter of the shell; height of outer whorl nearly three-sevenths of the diameter of the shell. Whorls eight or nine; inclusion two-thirds; umbilicus shallow, with step-like sides, nearly one-third of the diameter of the shell in width. Whorl subrectangular in section, higher than wide; indented to about one-fourth of its height by the preceding whorl; periphery flattened, feebly convex, with subangular margins, nearly one-fourth of the diameter of the shell in width; sides flat, slightly divergent; inner area well-defined, feebly convex, nearly at right angles to the plane of symmetry. Body-chamber occupying the last whorl. Chambers shallow, about twenty in a whorl; suture-line as in fig. 125 *c*. Test apparently quite smooth.

The whorl in this species is relatively higher, more compressed, and more rectangular than in *Prolec. mixolobus*, and its suture-line is also different.

Size. Phillips's type, which lacks the entire body-chamber, is 33 mm. in diameter.

Form. & Loc. British: Carboniferous Limestone: Grassington, Yorkshire. *Foreign*: Lower Carboniferous: Lautenthal, Hartz. Carboniferous: Russia.

C. 264. Phillips's type, 33 mm. in diameter: Grassington [1], Yorkshire. Since Phillips's figure was drawn, the matrix has been cleared from the side opposite to that figured; the specimen thus cleared is represented in fig. 125, *suprà* p. 261. *Gilbertson Coll.*

C. 1849. A fragment in matrix, showing part of the suture-line; Lautenthal, Hartz. *Presented by John Edward Lee, Esq.*, 1885.

C. 5756. An example, 26 mm. in diameter; Russia.
Transferred from Mus. Pract. Geol.

Genus **MEDLICOTTIA,** W. Waagen [2].

Syn. *Goniatites*, de Verneuil, 1845 [3] (pars), et auct.; *Aganides*, A. d'Orbigny, 1850 [4] (pars); *Ammonites*, C. G. Giebel, 1852 [5] (pars); *Sageceras*, E. v. Mojsisovics, 1872 [6] (pars), et auct.

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[1] The locality 'Bolland' given by Phillips in the text is altered to 'Grassington' in the list of 'Errata observed.'

[2] Pal. Indica, [13], vol. i. p. 83 (1880).

[3] Géol. Russie d'Europe, &c. vol. ii. p. 375.

[4] Prod. de Paléont. stratigr. vol. i. p. 116.

[5] Fauna der Vorwelt, vol. iii. p. 494.

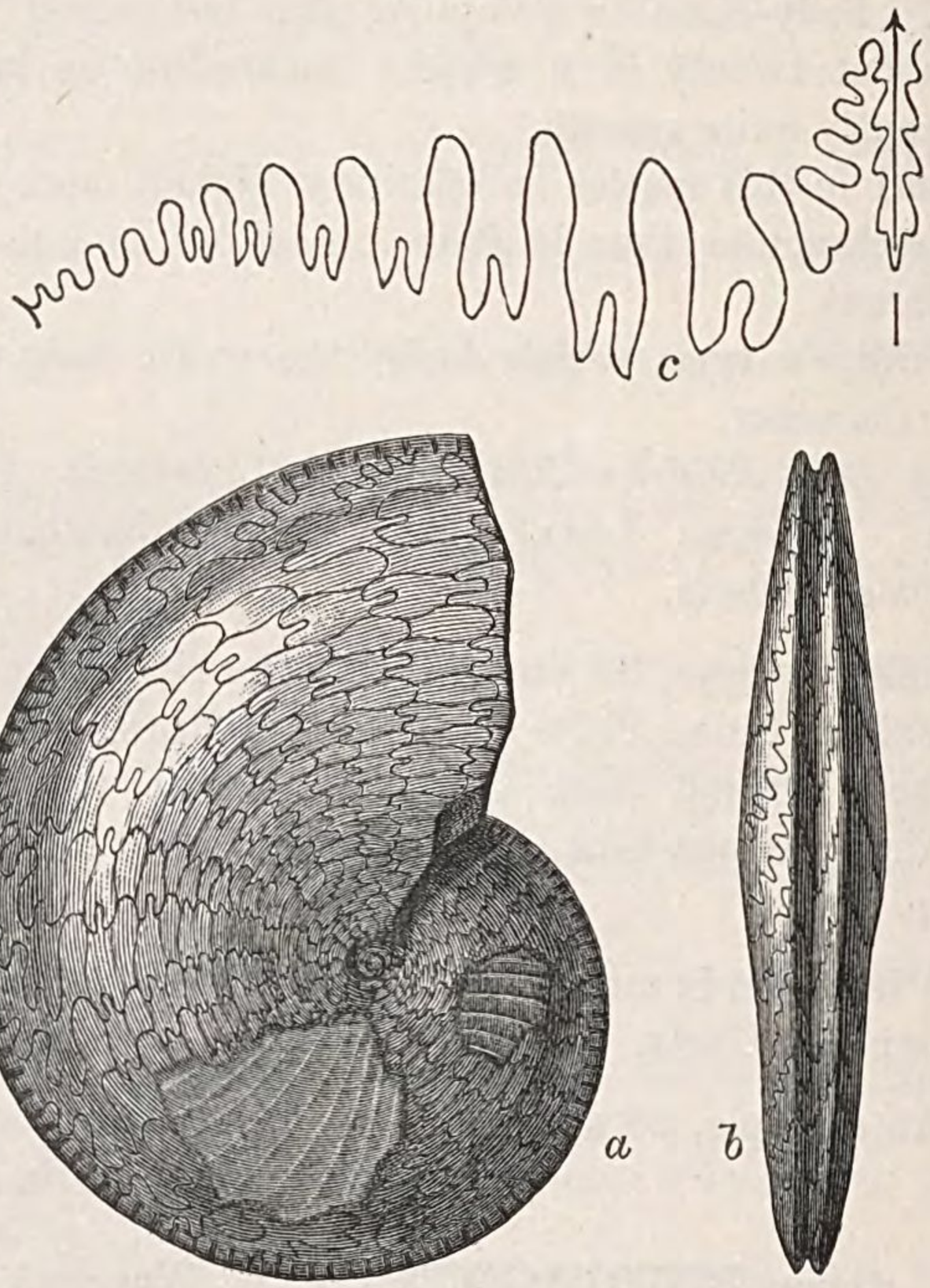
[6] Verhandl. d. k.-k. geol. Reichsanst. 1872, p. 316.

Type. *Goniatites Orbignyanus*, E. de Verneuil, in Murchison, de Verneuil, & de Keyserling, Géol. Russie d'Europe, vol. ii. 1845, p. 375, pl. xxvi. ff. 6 *a*, *b*, *c*.

Shell much compressed, discoidal, with high aperture and narrow umbilicus. Periphery with a sharp keel on either side, and with a median furrow. External saddle narrow, very high, rounded anteriorly, its sides with oblique indentations. All the lobes bifid; the lateral saddles rounded, entire or with a single indentation on either side.

Permo-Carboniferous.

Fig. 128.



Medlicottia Orbignyana.—*a*, lateral view, showing the suture-lines and fragments of the test with its delicate ornaments; *b*, peripheral view, showing the channelled periphery; *c*, suture-line. After de Verneuil.

Remarks.—The form of the external (peripheral or siphonal) lobe constitutes the principal distinction between this genus and *Sageceras*. Mojsisovics included both genera in his genus *Sageceras*, and was followed by Waagen, but subsequently [1] the latter author

[1] Pal. Indica, [13], vol. i. p. 83 (1880).

separated *Medlicottia* owing to the form of the siphonal lobe. Waagen states that "all the forms hitherto detected have the siphonal side either excavated and bounded on both sides by high and sharp crests, or the siphonal side is simply flattened, and defined on both sides by angular margins. In both cases the high and narrow saddles developed on each side of the siphonal lobe are situated exactly below the crests or the angulated margins; these saddles are strongly serrated from both sides, and the denticulations of the opposite sides of the saddle correspond exactly with each other; thus, little oval tubercles are formed, which appear not only on the casts, but also less strongly on the shell, and thus also those species, of which the sutural line is not exactly known, . . . can easily with all desirable certitude be attributed to the genus."

Hyatt [1] placed this genus in the family Prolecanitidæ; Zittel [2] in his 'Handbuch' transferred it to the Pinacoceratidæ; but later [3] this author also has placed it in the Prolecanitidæ.

Medlicottia Artiensis (M. v. Grünewaldt).

1857. *Goniatites falx*, E. Eichwald, Bull. Soc. Imp. Nat. Moscou, vol. xxx. no. 1, p. 212. [*Imperfectly described.*]
1860. *Goniatites Artiensis*, M. v. Grünewaldt, Mém. Acad. Imp. Sci. St. Pétersbourg, [7], vol. ii. no. 7, p. 138, pl. vi. ff. 3 *a*, *b*.
1860. *Goniatites falx*, E. d'Eichwald, Lethaea Rossica, vol. i. p. 1325.
1862. *Goniatites Orbignyanus*, V. Meller, Verhandl. Russ.-Kaiserl. Mineral. Gesell. St. Petersburg, 1859–62, p. 266.
1874. *Sageceras Artiensis*, A. Karpinsky, Verhandl. Russ.-Kaiserl. Mineral. Gesell. St. Petersburg, [2], vol. ix. p. 287.
1880. *Medlicottia artiensis*, W. Waagen, Pal. Indica, [13], vol. i. p. 83.
1885. *Medlicottia falx* (pars), P. Krotow, Trudui Obshchest. Estest. Kazansk. Unīv. vol. xiii. no. 5, p. 210, pl. ii. ff. 1–7.
1888. *Medlicottia falx*, P. Krotow, Mém. Com. géol. St. Pétersbourg, vol. vi. p. 475.
1889. *Medlicottia artiensis*, A. Karpinsky, Mém. Acad. Imp. Sci. St. Pétersbourg, [7], vol. xxxvii. p. 26, pl. i. ff. 1 *a–o*.

Sp. Char. Shell discoidal, much compressed, involute; greatest thickness rather nearer the periphery than the umbilicus, about one-fifth of the diameter of the shell; height of outer whorl (in immature specimens) about three-fifths of the diameter of the shell. Whorls (? number); inclusion considerable, increasing rapidly in the adult;

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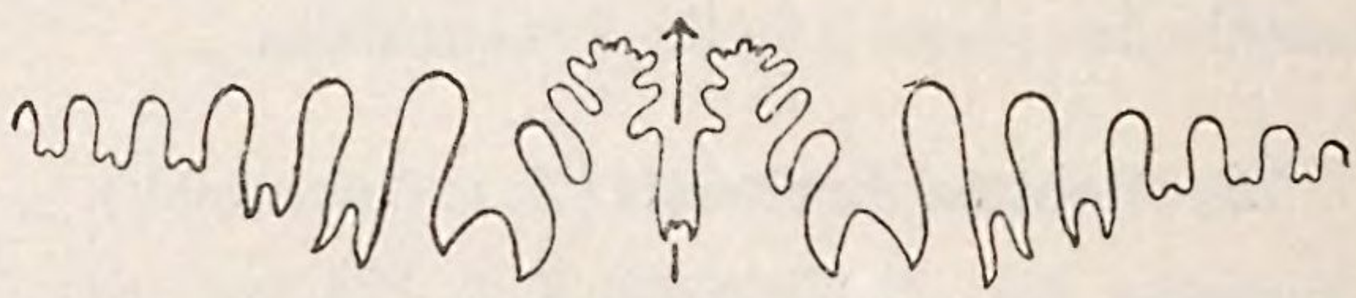
[1] Proc. Boston Soc. Nat. Hist. vol. xxii. 1884, p. 334.
[2] Handb. d. Palæont. vol. ii. 1884, p. 434.
[3] Grundzüge d. Palæont. 1895, p. 401.

umbilicus narrow, rather deep. Whorl trapezoidal in section, much higher than wide; periphery truncated, with a wide, fairly deep, angular, median groove, and with somewhat coarsely serrated margins; sides feebly convex and slightly convergent at the outer part of the whorl, almost parallel at the inner part of the whorl; inner area exceedingly narrow. Body-chamber (? length). Chambers shallow; suture-line as in fig. 129. Test thin, ornamented with very delicate sigmoidal lines of growth, and on the outer third of the lateral area also with fine imbricating ridges, which are slightly concave forwards; each peripheral margin with rather coarse flattened ribs, which, passing obliquely backwards from the periphery, extend only a short distance over the lateral area, and impart to each margin a serrated appearance.

Fig. 129.



Suture-line of *Medlicottia Artiensis*; natural size.
After Karpinsky.

Size. Shell attaining a diameter of 105 mm., but examples of this species are usually fragmentary.

Form. & Loc. Artinsk Stufe (Permo-Carboniferous): Perm, Russia.

C. 1508. Three fragments, the largest having a diameter of 67 mm., the smallest exhibiting the septa and a fragment of the test; also a crushed specimen 11 mm. in diameter.

Purchased, 1886.

Genus **AGATHICERAS,** G. G. Gemmellaro[1].

Syn. *Goniatites*, A. Karpinsky, 1874[2] (pars); *Goniatites* (*Glyphioceras*?), P. Krotow, 1885[3]; *Adrianites*, G. G. Gemmellaro, 1888[4].

Type. *Agathiceras Suessi*, G. G. Gemmellaro, Giorn. d. Sci. Nat. ed Econom. Palermo, vol. xix. 1888, p. 77, pl. vi. ff. 1–4; pl. vii. f. 36.

Shell spherical or discoidal, narrowly or widely umbilicated,

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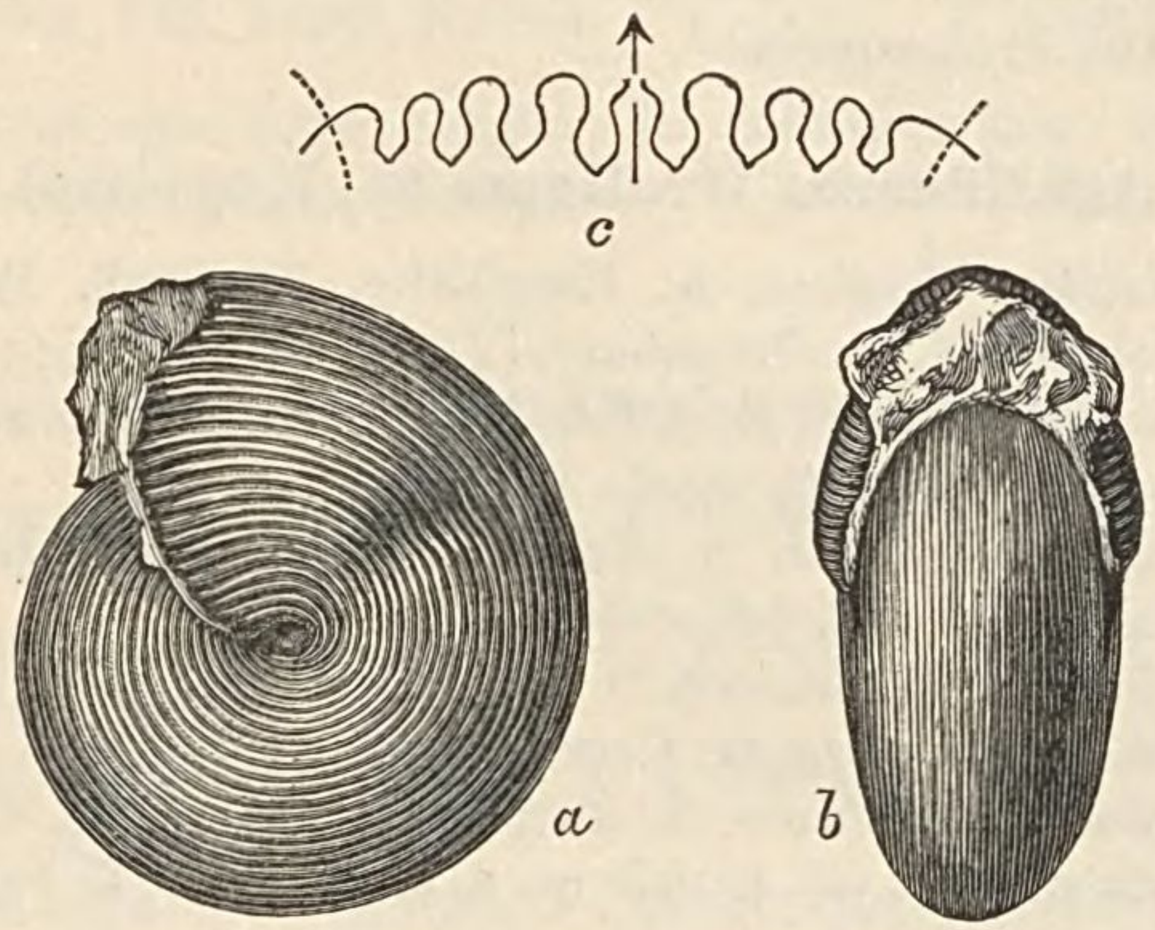
[1] Giorn. d. Sci. Nat. ed Econom. Palermo, vol. xix. 1888, p. 75.
[2] Verhandl. Russ.-Kaiserl. Mineral. Gesell. St. Petersburg, [2], vol. ix. p. 288.
[3] Trudui Obshchest. Estest. Kazansk. Univ. vol. xiii. pt. v. p. 198.
[4] Giorn. d. Sci. Nat. ed Econom. Palermo, vol. xix. p. 39.

spirally or transversely ornamented. Aperture somewhat constricted, with a narrow forward prolongation on each side of the periphery. Saddles club-shaped, somewhat constricted posteriorly, not indented. Lobes not incised, obtusely pointed.

Permo-Carboniferous.

Fig. 130.



Agathiceras Suessi.—*a*, lateral view, showing spiral ornaments; *b*, front view, showing the somewhat constricted aperture; *c*, suture-line. After Gemmellaro.

Remarks. The forms of this genus were first found in the Artinsk Stufe of the Ural Mts., and afterwards in Sicily and in Central Asia. Subsequently several species were described from corresponding beds in Sicily by Prof. Gemmellaro, and referred to the genera *Agathiceras* and *Adrianites*. The principal distinctions between these two genera seem to be (1) the length of the body-chamber, which in *Adrianites* occupied from $1\frac{1}{3}$ to $1\frac{1}{2}$ whorls, and in *Agathiceras* only a whorl; and (2) the form of the median saddle of the suture-line, this being bottle-shaped in *Agathiceras*, and with a median indentation in *Adrianites*. This latter character seems, however, to be unimportant, depending as it does upon the change in position of the siphonal necks, as mentioned by Karpinsky. The length of the body-chamber is more important, but between some forms of *Agathiceras* and some forms of *Adrianites* there is only a slight difference, whilst it is not of the same length in all the typical *Adrianites*. We have therefore followed Karpinsky and von Zittel in combining these two genera under the name *Agathiceras*.

This genus differs from *Prolecanites* in having a bottle-shaped saddle at the centre of the periphery, in which respect it evidently

resembles Hyatt's *Schistoceras*[1], a genus that includes "a single species which is not figured or described, but can be readily distinguished by its large bottle-shaped siphonal saddle."

Gemmellaro, in instituting the two genera, *Adrianites* and *Agathiceras*, placed the former in the *Arcestidæ* and the latter in the *Prolecanitidæ*. Karpinsky, who united the two genera under the name *Agathiceras*, placed the genus in the *Arcestidæ*[2]; von Zittel places it in the *Prolecanitidæ*[3].

Agathiceras Uralicum (A. Karpinsky).

1874. *Goniatites Uralicus*, A. Karpinsky, Verhandl. Russ.-Kaiserl. Mineral. Gesell. St. Petersburg, [2], vol. ix. p. 288, pl. xii. ff. 1–5.
1878. *Goniatitus uralicus*, H. Abich, Geol. Forsch. in den Kaukasischen Ländern, pt. i. p. 119, woodc. ff. 5, 6.
1883. *Goniatites uralicus*, A. Karpinsky, Verhandl. Russ.-Kaiserl. Mineral. Gesell. [2], vol. xviii. p. 216.
1885. *Goniatites* (*Glyphioceras*?) *Uralicus*, P. Krotow, Trudui Obshchest. Estest. Kazansk. Unīv. vol. xiii. pt. 5, p. 198.
1889. *Agathiceras uralicum*, A. Karpinsky, Mém. Acad. Imp. Sci. St. Pétersbourg, [7], vol. xxxvii. no. 2, p. 64, pl. iv. ff. 4 *a*, *e*.

Sp. Char. Shell rather small, rapidly increasing, involute; greatest thickness at a short distance from the umbilicus, about one-half of the diameter of the shell; height of outer whorl nearly four-sevenths of the diameter of the shell. Whorls few (? number); inclusion almost complete; umbilicus small, deep. Whorl semielliptical in section, a little wider than high; indented to about one-third of its height by the preceding whorl; periphery broadly convex, continuous with the sides; sides convex, their inner portion sloping into the umbilicus without forming any distinct inner area. Body-chamber occupying nearly a complete whorl. Chambers (? depth); suture-line as in fig. 131. Test ornamented with

Fig. 131.

Suture-line of *Agathiceras Uralicum*. After Karpinsky.

raised spiral ridges from one-third to one-half of a millimetre apart; and with very faint lines of growth, which form a shallow forwardly-concave sinus on the sides, and a similar shallow sinus on

[1] Proc. Boston Soc. Nat. Hist. vol. xxii. 1884, p. 336.
[2] Mém. Acad. Imp. Sci. St. Pétersbourg, [7], vol. xxxvii. no. 2, 1889, p. 63.
[3] Grundzüge d. Palæont. 1895, p. 401.

the periphery. Usually with from one to four constrictions following the direction of the lines of growth.

Size. Karpinsky figures (Mém. Acad. Imp. Sci. St. Pétersbourg, [7], vol. xxxvii. pl. iv. f. 4 *a*) an example 30 mm. in diameter.

Form & Loc. Artinsk Stufe (Permo-Carboniferous): Perm, Russia.

C. 1503. Three examples, ranging in diameter from 11 to 18·5 mm.; River Ufa, Perm, Russia. *Purchased*, 1886.

C. 1504. Three specimens, ranging in diameter from about 12 to 18 mm.; Perm, Russia. *Purchased*, 1886.

Agathiceras? micromphalum (J. Morris).

1845. *Bellerophon micromphalus*, J. Morris, in Strzelecki's Phys. Descrip. N. S. Wales, p. 288, pl. xviii. f. 7.
1847. *Bellerophon micromphalus*, F. M'Coy, Ann. Mag. Nat. Hist. vol. xx. p. 308.
1849. *Bellerophon micromphalus*, J. D. Dana, Geology U. S. Explor. Exped. p. 708, pl. x. f. 6.
1854. *Bellerophon micromphalus*, J. Grange, Dumont d'Urville's Voyage au Pôle Sud, vol. ii. p. 89.
1860. *Bellerophon micromphalus*, W. B. Clarke, Researches S. Gold Fields, N. S. Wales, p. 288.
1877. *Goniatites micromphalus*, L. G. de Koninck, Foss. Pal. Nouvelles-Galles du Sud, p. 339, pl. xxiv. f. 5.
1878. *Goniatites micromphalus*, R. Etheridge, jun., Catal. Australian Foss. p. 89.
1880. *Goniatites micromphalus*, R. Etheridge, jun., Proc. Roy. Phys. Soc. Edinburgh, vol. v. p. 304.
1890. *Goniatites micromphalus*, A. H. Foord, Geol. Mag. [3], vol. vii. p. 104, pl. v. figs. 10, 10 *a*.
1892. *Goniatites micromphalus*, R. Etheridge, jun., in Jack & Etheridge, Geol. and Palæont. Queensland and New Guinea, p. 294.
1894. *Goniatites* (*Prolecanites?*) *micromphalus*, R. Etheridge, jun., Records Geol. Surv. N. S. Wales, vol. iv. pt. i. p. 36, pl. vii. ff. 9–14.
[*Not* 1850. *Goniatites micromphalus*, F. A. Roemer, Palæontogr. vol. iii. p. 19, pl. iii. fig. 30.]

Sp. Char. Shell of medium size, involute, rather inflated, with a narrowly rounded periphery; greatest thickness almost close to the umbilicus, about two-thirds of the diameter of the shell; height of outer whorl about two-thirds of the diameter of the shell. Whorls three or four; inclusion almost complete; umbilicus small. Whorl obtusely cordate in section, about as high as wide; indented to about one-half of its height by the preceding whorl; periphery

convex; sides inflated, depressed at the umbilicus without forming a distinct inner area. Body-chamber (? length). Suture-lines (fig. 132) "moderately close," ... "both the lobes and saddles are nearly similar in shape, broadly sagittiform, or somewhat club-shaped (sub-pyriform)." Test ornamented with "microscopic spiral and transverse lines, breaking the surface into a series of the smallest squares, presenting, when magnified, the appearance of a toothed or rasp-like surface." In internal casts each whorl with about two broad shallow backwardly-directed constrictions.

Fig. 132.

Suture-line of *Agathiceras*? *micromphalum*. After Etheridge.

Since none of the specimens in the Collection exhibit either the test or the suture-lines, we have quoted Mr. Etheridge's description of them. "In no instance," he says, "is the shell sufficiently clear of its cover to expose the lobes and saddles of an entire suture. As the ventral lobe is not visible the section to which this species belongs cannot be determined with certainty, but probably it falls within Hyatt's Prolecanitidæ, and may be referable either to *Sandbergeroceras*, Hyatt, or *Prolecanites*, Mojsisovics. . . . On the other hand our shells have not a large umbilicus as in *Sandbergeroceras*, and the surface is not smooth as in *Prolecanites*. On the whole, and omitting from consideration the ventral lobe, they seem to come nearer to the latter."

Frech[1], in a notice of Mr. Etheridge's paper, says the general form and spiral ornaments of this species agree with *Gastrioceras*, while its lobes agree with those of *Prolecanites* or *Pronorites*; he considers it to be referable to a new genus, which, however, cannot be completely diagnosed as the peripheral portion of the suture-line is not known. The character of the suture-line and the general form of the shell seem to us to ally the species rather with *Agathiceras*, and, indeed, it comes very near *Agathic. Uralicum*, from the Artinsk Stufe (Permo-Carboniferous) of Russia.

Size. Shell attaining a diameter of about 32 mm.

Form. & Loc. Permo-Carboniferous: New South Wales; Western Australia.

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[1] Neues Jahrb. 1896, p. 501.

96905. Five specimens, ranging in diameter from 11 to 26 mm.; two of which have been sectioned, but exhibit no septa: N.S. Wales. *Strzelecki Coll. Purchased*, 1879.

G. 5226. Crushed example, 26 mm. in diameter, in matrix; N.S. Wales. *Presented by C. Purdon Clarke, Esq.*, 1889.

G. 7423. The small example, in matrix, figured in Geol. Mag. [3], vol. vii. 1890, pl. v. f. 10 *a*; Liverynga, Kimberley District, Western Australia.
Presented by the Government of Western Australia per H. P. Woodward, Esq., 1892.

C. 4156. Specimen figured in Geol. Mag. [3], vol. vii. 1890, pl. v. f. 10; Liverynga, Kimberley District, Western Australia.
Presented by the Government of Western Australia per H. P. Woodward, Esq., 1892.

C. 5763. Six specimens, ranging in diameter from 20 to 25 mm.; locality unrecorded, but doubtless from same as no. 96905.
History unknown.

C. 5764. Small block containing several specimens; also a detached specimen which has been sectioned: "Paddock of the Spread Eagle Inn, 3 miles S. West of Maitland," N. S. Wales. *Transferred from Mus. Pract. Geol.*

C. 5765. Fairly well-preserved example, 24 mm. in diameter, from the same locality. *Transferred from Mus. Pract. Geol.*

C. 5766. Example, 23 mm. in diameter, in matrix; Carboniferous (Lower Marine Beds), Ravensfield, New South Wales.
Duplicate from series exhibited at Col.-Indian Exhibition, 1886 (*Official Catal. p.* 164, *no.* 281), *per Mr. Letts, Imperial Institute*, 1893.

Genus **BELOCERAS**, A. Hyatt [1].

Syn. *Ammonites*, E. Beyrich, 1837 [2] (pars), et auct.; *Goniatites*, d'Archiac & de Verneuil, 1842 [3] (pars), et auct.; *Aganides*, A. d'Orbigny 1850 [4] (pars); *Pinacoceras*, E. v. Mojsisovics, 1873 [5] (pars).

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[1] Proc. Boston Soc. Nat. Hist. vol. xxii. 1884, p. 333.
[2] De Goniatitis in montibus rhenanis occurrentibus, p. 9.
[3] Trans. Geol. Soc. [2], vol. vi. p. 383.
[4] Prod. de Paléont. stratigr. vol. i. p. 59.
[5] Abhandl. k.-k. geol. Reichsanst. Wien, vol. vi. pp. 43, 69.

Type. *Ammonites multilobatus*, E. Beyrich, De Goniatitis in montibus rhenanis occurrentibus, 1837, p. 9, pl. i. f. 9.

Shell discoidal, much compressed, umbilicated, with narrow periphery; suture-line with numerous pointed lobes and saddles resulting from the subdivision of the external and lateral saddles; external lobe divided.

Devonian.

This genus comprises only the type-species. The development of the lobes and saddles has been traced by Sandberger in the later stages and in the earlier stages by Dr. Branco. Mojsisovics referred the type of this genus to *Pinacoceras*, but its suture-line never attains the complexity of the members of that genus.

Beloceras sagittarium (G. & F. Sandberger).

[Fig. 133 *a*, *b*.]

1837. *Ammonites multilobatus*, E. Beyrich, Beiträge Kenntn. Verstein. rhein. Uebergansgeb. p. 33, pl. i. f. 9.

1842. *Goniatites tenuistriatus*, d'Archiac & de Verneuil, Trans. Geol. Soc. [2], vol. vi. p. 343, pl. xxvi. ff. 7, 7 *a*, *b*; 8, 8 *a*. [Suture-line neither described nor figured.]

1842. *Goniatites multilobatus*, d'Archiac & de Verneuil, ibid. p. 383.

1848. *Goniatites multilobatus*, H. G. Bronn, Gesch. d. Natur, vol. iii. p. 543.

1850. *Aganides multilobatus*, A. d'Orbigny, Prod. de Paléont. stratigr. vol. i. p. 59.

1850. *Aganides tenuistriatus*, A. d'Orbigny, ibid. vol. i. p. 61.

1850–56. *Goniatites sagittarius*, G. & F. Sandberger, Verstein. rhein. Schichtensyst. Nassau, p. 77, pl. iv. ff. 3 *a–h* (*not* ff. 3 *i–l*), p. 56, woodc. f. 7.

1852. *Ammonites multilobatus*, C. G. Giebel, Fauna der Vorwelt, vol. iii. p. 493.

1873. *Pinacoceras multilobatum*, E. von Mojsisovics, Abhandl. k.-k. geol. Reichsanst. Wien, vol. vi. pp. 43, 69.

1879. *Goniatites multilobatus*, F. Roemer, Zeitschr. deutsch. geol. Gesell. vol. xxxi. p. 660.

1880. *Goniatites multilobatus*, F. Roemer, Geol. Mag. [2], vol. vii. p. 145, pl. v. ff. 1, 2.

1880. *Goniatites multilobatus*, W. Branco, Palæontogr. vol. xxvii. pl. vi. ff. vi. *a–d*.

1882. *Goniatites multilobatus*, E. Holzapfel, Palæontogr. vol. xxviii. p. 237, pl. xlv. (ii.) ff. 2–6.

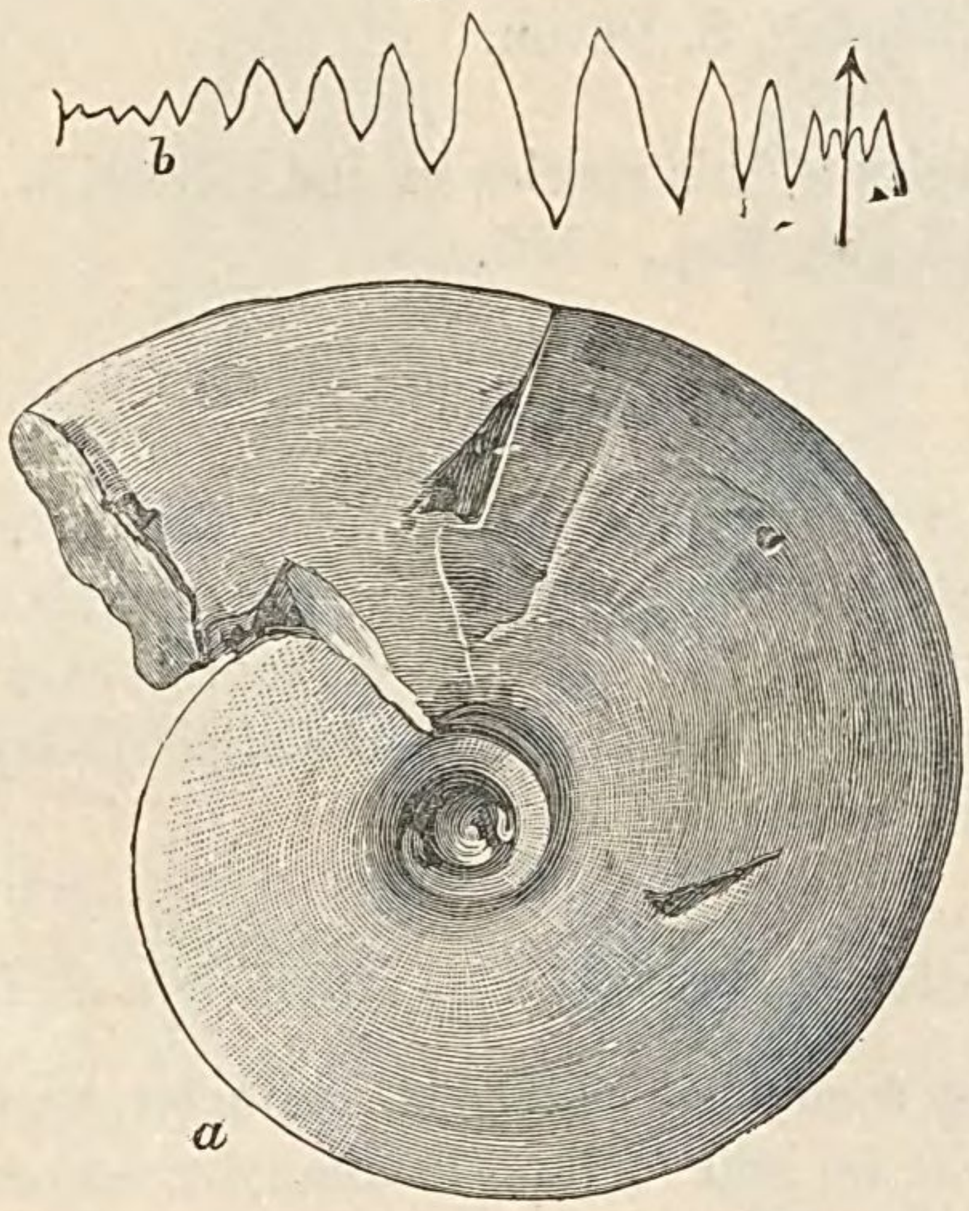
1884. *Beloceras multilobatum*, A. Hyatt, Proc. Boston Soc. Nat. Hist. vol. xxii. p. 333.

1884. *Goniatites* (*Beloceras*) *multilobatus*, K. A. Zittel, Handb. Palæont. vol. ii. p. 415, woodc. f. 562; p. 421, woodc. f. 581.

1887. *Goniatites* (*Beloceras*) *multilobatus*, F. Frech, Zeitschr. deutsch. geol. Gesell. vol. xxxix. pp. 389, 428, 432.
1889. *Goniatites multilobatus*, E. Kayser, Neues Jahrb. i. p. 184.
1890. *Beloceras multilobatum*, G. Steinmann & L. Döderlein, Elem. d. Paläont. p. 396, woodc. f. 476.
1890. *Goniatites sagittarius*, W. A. E. Ussher, Quart. Journ. Geol. Soc. vol. xlvi. p. 509.
1896. *Goniatites* (*Beloceras*) *multilobatus*, H. de Peetz, Travaux de la Sect. géol. du Cabinet de sa Majesté, St. Pétersbourg, vol. i. livr. 3, pp. 174 & 197.

[*Not* 1832. *Ammonites multilobatus*, H. G. Bronn, Neues Jahrb. p. 159; 1843. *Ammonites multilobatus*, A. v. Klipstein, Beitr. geol. Kenntn. östlichen Alpen, p. 129, pl. ix. f. 1.]

Fig. 133.



Beloceras sagittarium.—*a*, lateral aspect of a specimen in the British Museum Collection; *b*, suture-line, copied from Sandberger.

Sp. Char. Shell discoidal, very compressed, lenticular, somewhat elliptical; greatest thickness near the umbilicus, one-fifth or one-sixth of the diameter of the shell; height of outer whorl about one-half of the diameter of the shell. Whorls four or five; inclusion about three-fourths; umbilicus not very deep, about one-seventh of the diameter in width, exposing the sloping inner margins of the inner whorls. Whorl more or less acutely sagittate in section, somewhat variable, usually nearly three times as high as wide; indented to rather more than one-third of its height by the preceding whorl; periphery very narrow, mostly nearly flat, more rarely convex, with subangular margins; sides feebly convex.

almost flat, sometimes with a shallow longitudinal furrow close to the margin of the periphery; inner area sloping towards the umbilicus, and in the outer whorl with a narrow longitudinal band near the suture. Body-chamber (? length). Chambers numerous, very shallow; suture-line as in fig. 133 *b*. Test thin, almost smooth, ornamented with feeble flattened falciform riblets, which are widest and backwardly turned near the periphery, a very fine line occupying each interspace; ornaments forming a very deep sinus on the periphery. 'Wrinkle-layer' formed of fine, close-set, transverse incised lines, which are disposed almost radially on the lateral area and curve backwards near the suture of the shell.

Size. Shell attaining a diameter of more than 115 mm.

Form. & Loc. Upper Devonian: Adorf, Waldeck; Lower Dunscombe, near Chudleigh, S. Devon.

All the examples of this species in the collection were presented by John Edward Lee, Esq., 1885.

a. *Adorf, Waldeck.*

C. 1845. Two well-preserved examples, in matrix; their longest diameters being 30 and 55 mm. respectively. The larger example (fig. 133 *a*) shows the sculpture of the shell; both specimens bear traces of the 'wrinkle-layer' on the first portion of the last whorl.

b. *Lower Dunscombe, near Chudleigh, S. Devon.*

C. 1834 e. Two somewhat elliptical examples, partly obscured by matrix, 55 and 77 mm. in diameter respectively.

C. 1835. A small abraded specimen, figured in Geol. Mag. [2], vol. vii. (1880) pl. v. f. 1.

C. 1836. The specimen figured in Geol. Mag. [2], vol. vii. (1880) pl. v. f. 2.

C. 1852. Very imperfect specimen, showing the 'wrinkle-layer' on the first portion of the last whorl.

C. 1959. Fairly well-preserved example, 93·5 mm. in its longest diameter, also showing the 'wrinkle-layer'; also an imperfect specimen, whose longest diameter is 59 mm.

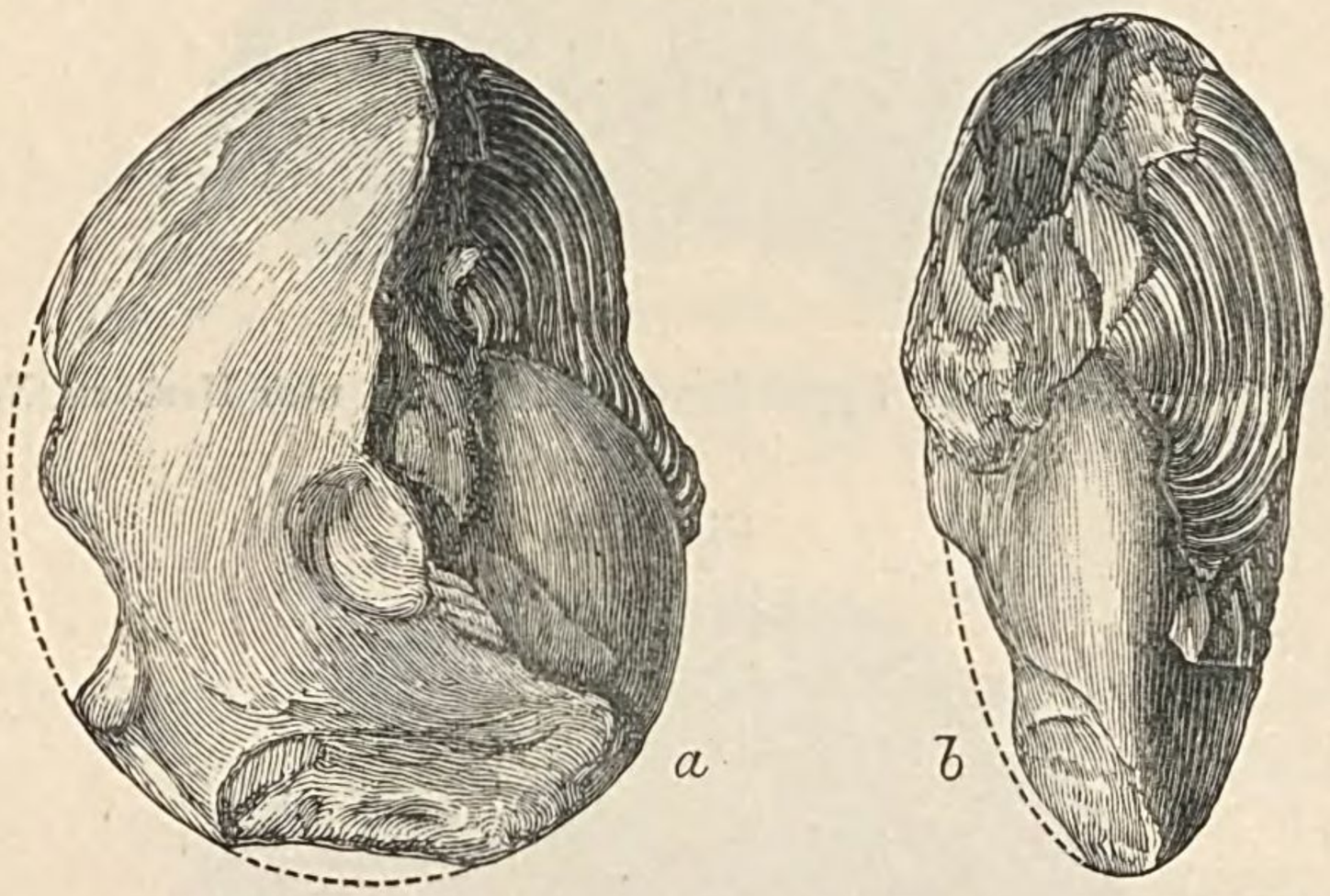
C. 1969. Two specimens 56 and 81 mm. in diameter respectively.

APTYCHI OF GONIATITES.

The following specimens from the Upper Devonian (*Intumescens*-stage) of Bicken, near Herborn, Nassau, Germany, were described and figured by Dr. H. Woodward in the Geol. Mag. [3], vol. ii. 1885, p. 345 *et seqq.*, pl. ix. ff. 1–6 :—

C. 650. The example of *Gephyroceras intumescens* [1] (see *suprà*, p. 68) with Aptychus *in situ*, figured in Geol. Mag. [3], vol. ii. 1885, pl. ix. ff. 1, 2. (Fig. 134.) *Purchased*, 1884.

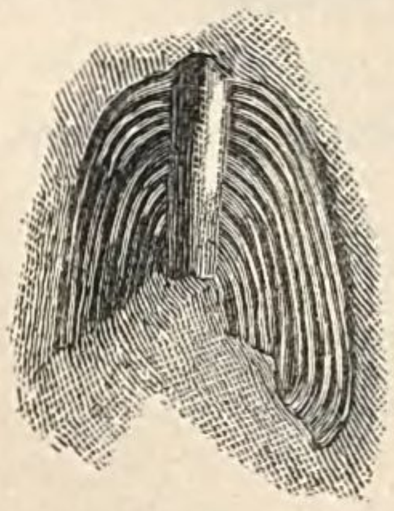
Fig. 134.



Gephyroceras intumescens with Aptychus *in situ*.—*a*, lateral aspect ; *b*, front view. Upper Devonian ; Bicken, near Herborn, Nassau.

C. 650 a, b, c. *Aptychi*, figured *op. cit.* pl. ix. ff. 4, 5, 6. (Figs. 135, 136, 137.) *Purchased*, 1884.

Fig. 135.



Aptychus of Goniatite. Upper Devonian ; Bicken, near Herborn, Nassau.

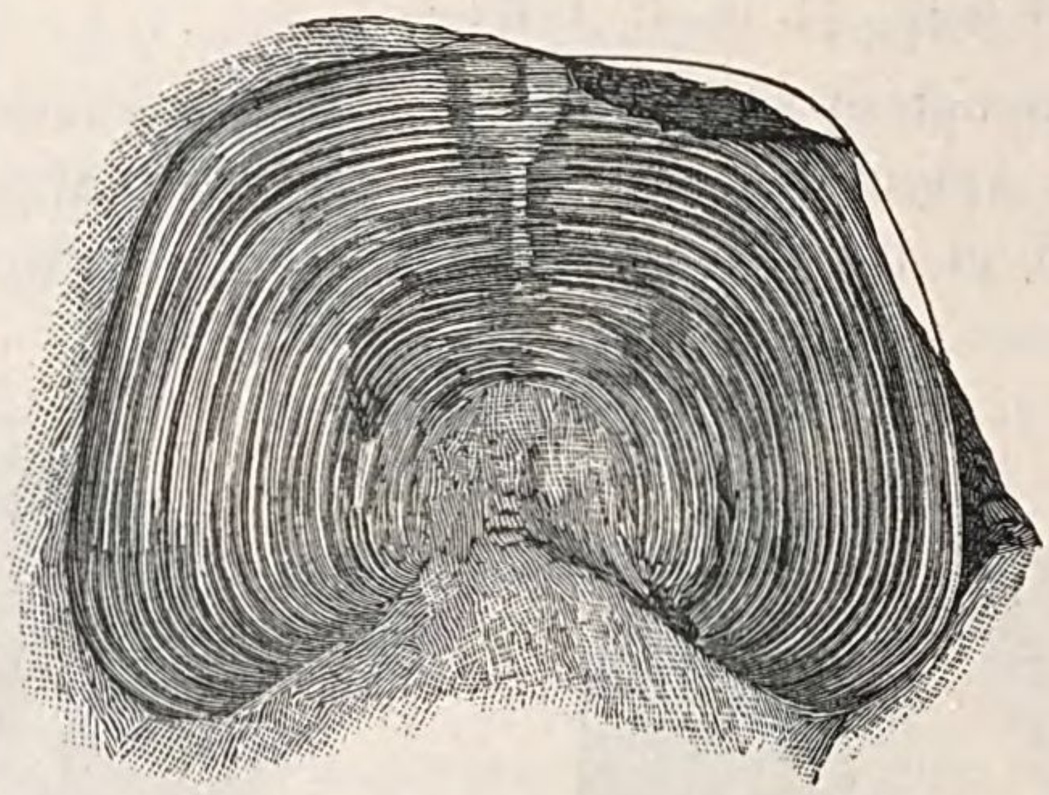
Fig. 136.

Aptychus of Goniatite. Upper Devonian ; Bicken, near Herborn, Nassau.

[1] The discovery of an *Aptychus* lying in the body-chamber of *Goniatites intumescens* from the Upper Devonian of Bicken was briefly noticed by E. Kayser in 1882 (Zeitschr. deutsch. geol. Gesell. vol. xxxiv. p. 819).

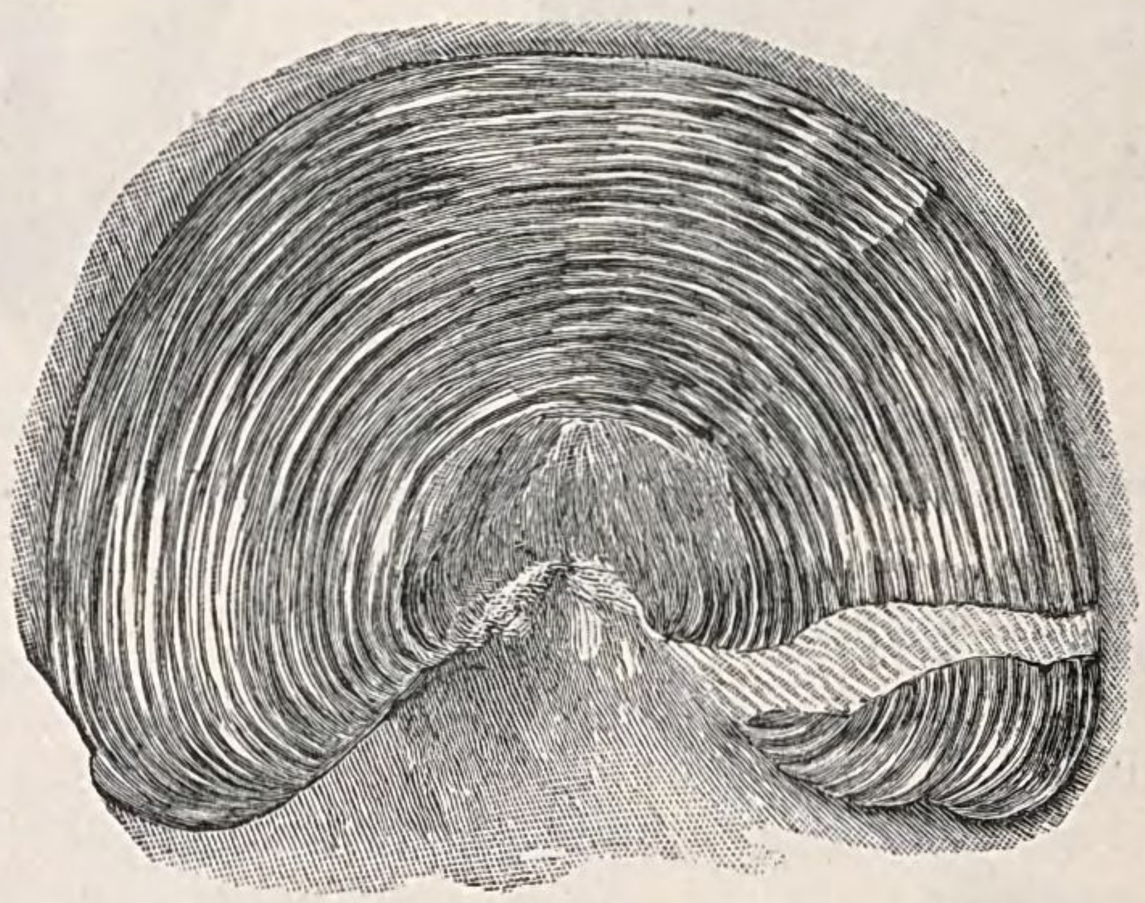
C. 1717. *Aptychus*, figured *op. cit.* pl. ix. f. 3. (Fig. 138.)
Presented by John Edward Lee, Esq., 1885.

Fig. 137.



Aptychus of Goniatite. Upper Devonian; Bicken, near Herborn, Nassau.

Fig. 138.



Aptychus of Goniatite. Upper Devonian; Bicken, near Herborn, Nassau.

INDETERMINABLE GONIATITES.

(a) *Devonian.*

36280. Section in small polished slab, showing the body-chamber to have occupied $1\frac{1}{4}$ whorls: Devonian; Teignmouth, Devon. *Purchased*, 1856.

89098. Section in matrix: Middle Devonian; Mudstone Bay, S. Devon. *Bowerbank Coll.*

C. 517. Small slab bearing impression of a portion of a rather large shell, possibly referable to *Agoniatites*: Lower Devonian; Bundenbach. *Purchased*, 1884.

C. 601 d, C. 1960 c, C. 1967 d. Three small specimens, in matrix: Upper Devonian; Saltern Cove, near Torquay, S. Devon. *Presented by John Edward Lee, Esq.*, 1885.

C. 1815. Four very much abraded specimens, one being sectioned: Middle Devonian; Mudstone Bay, S. Devon. *Presented by John Edward Lee, Esq.*, 1885.

(b) *Carboniferous.*

C. 763. Median section of the inner whorls of a ribbed Goniatite from the Lower Coal Measures, Halifax, Yorkshire, mounted as a microscopic slide. This section exhibits the initial-chamber, the siphuncle, and the septal necks. *Presented by W. Cash, Esq., F.G.S.*, 1885.

(c) *Trias* (derived from *Devonian*).

C. 600. Eight examples in water-worn nodules, cut and polished: Trias (derived from Devonian); Labrador Tea Gardens, Teignmouth, S. Devon. *Presented by John Edward Lee, Esq.*, 1885.

INCERTÆ SEDIS.

"Goniatites carina," J. Phillips.

1836. *Goniatites carina*, J. Phillips, Geol. Yorks. pt. ii. p. 237, pl. xx. ff. 63, 64 (*not* of de Koninck) [1].
1843. *Goniatites carina*, J. Morris, Cat. Brit. Foss. p. 179.
1848. *Goniatites carina* (pars), H. G. Bronn, Gesch. d. Natur, vol. iii. p. 541.
1850. *Aganides carina* (pars), A. d'Orbigny, Prod. de Paléont. stratigr. vol. i. p. 116.
1852. *Ammonites atratus* (pars), C. G. Giebel, Fauna der Vorwelt, vol. iii. p. 462.
1854. *Goniatites carina*, J. Morris, Cat. Brit. Foss. 2nd ed. p. 303.
1878. *Goniatites carina* (pars), J. J. Bigsby, Thesaur. dev.-carb. p. 337
1888. *Goniatites carina*, R. Etheridge, Brit. Foss. vol. i., Palæozoic, p. 311.

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[1] See *suprà*, p. 225.

Phillips described this species as follows :—"Lenticular, back carinated, smooth." We have carefully examined the type-specimen, which is in the British Museum Collection, but fail to detect any signs of septa. Its general form reminds one of the genus *Leveillia*. This is not the species described by De Koninck[1] as *Gon. carina*, for in that the umbilicus is closed, while Phillips's type-specimen is rather widely umbilicated. Giebel[2] regarded this species as identical with the "*Ammonites atratus*" of Goldfuss.

C. 274. The type-specimen, 12·5 mm. in diameter. Carboniferous Limestone: Bolland, Yorkshire. *Gilbertson Coll.*

"Nautilus goniolobus," J. Phillips.

1836. *Nautilus goniolobus*, J. Phillips, Geol. Yorks. pt. ii. p. 232, pl. xvii. f. 23.
1843. *Nautilus goniolobus*, J. Morris, Cat. Brit. Foss. p. 182.
1843. *Nautilus goniolobus* ?, J. E. Portlock, Geol. Londonderry, p. 406, pl. xxix A. f. 8.
1848. *Nautilus goniolobus*, H. G. Bronn, Gesch. d. Natur, vol. iii. p. 793.
1849. *Nautilus goniolobatus*, T. Brown, Foss. Conch. p. 36, pl. xxv. f. 3.
1850. *Nautilus goniolobus*, A. d'Orbigny, Prod. d. Paléont. stratigr. vol. i. p. 111.
1854. *Nautilus goniolobus*, J. Morris, Cat. Brit. Foss. 2nd ed. p. 308.
1888. *Nautilus goniolobus* ?, R. Etheridge, Brit. Foss., vol. i. Palæozoic, p. 314.

Phillips's description of this species is as follows :—"Subglobose, involute, umbilicus small; sutures retroflexed into a round dorsal sinus; first lateral lobe angular; second inconspicuous." The grooves on the specimen that Phillips took to be septa we consider to be sulci, and we think it highly probable that the fossil should be referred to the Goniatites; but as we have not been able to see the septa, its position is still uncertain. It bears some resemblance to De Koninck's[3] (not Phillips's[4]) *Goniatites inconstans*.

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[1] Descr. Anim. Foss. de la Belgique, 1842–44, p. 582, pl. l. ff. 4 *a*, *b*, *c*; Faune Calc. Carb. de la Belgique (Ann. Mus. Roy. d'Hist. nat. de Belgique, sér Paléont. vol. v.), pt. ii. p. 116, pl. l. ff. 13, 13 *a*.

[2] Fauna der Vorwelt, vol. iii. p. 462.

[3] Fauna Calc. Carb. de la Belgique (Ann. Mus. Roy. d'Hist. nat. de Belgique, sér. Paléont. vol. v.), pt. ii. 1882, p. 120, pl. xlviii. ff. 4–9.

[4] Pal. Foss. Cornwall, Devon, & W. Somerset, 1841, p. 123, pl. li. ff. 238 *a–e*.

The fragment figured by Portlock (*loc. cit.*) from the Clogher Shales, Londonderry, appears to belong to this species.

C. 221. The type-specimen, 9·5 mm. in diameter and 8 mm. thick. Carboniferous Limestone: Bolland, Yorkshire.

Gilbertson Coll.

The following Devonian and Carboniferous species were originally described as *Goniatites*, but are now excluded from that group:—

(*a*) Devonian.

"Goniatites pentangularis," G. F. Whidborne.

1890. *Goniatites pentangularis*, G. F. Whidborne, Devon. Fauna S. England (Mon. Pal. Soc.), pt. 2, p. 79, pl. vii. ff. 2, 2 *a*.

This species is a Gasteropod, and referable to the genus *Leveillia*. Mr. R. B. Newton considers it to be identical with *Leveillia bifida* (G. & F. Sandberger).

G. 9845. The type-specimen. Middle Devonian: Barton, S. Devon.

Presented by John Edward Lee, Esq., 1885.

(*b*) Carboniferous.

"Goniatites intercostalis," J. Phillips.

1836. *Goniatites intercostalis*, J. Phillips, Geol. Yorks. pt. ii. p. 237, pl. xx. ff. 61, 62.
1843. *Goniatites intercostalis*, J. Morris, Cat. Brit. Foss. p. 179.
1844. *Goniatites intercostalis*, F. M'Coy, Synop. Carb. Foss. Ireland, p. 13.
1848. *Goniatites intercostalis*, H. G. Bronn, Gesch. d. Natur, vol. iii. p. 543.
1852. *Goniatites intercostalis*, C. J. Giebel, Fauna der Vorwelt, vol. iii. p. 746.
1854. *Goniatites intercostalis*, J. Morris, Cat. Brit. Foss. 2nd ed. p. 303.
1855–57. *Goniatites intercostalis*, J. Kelly, Journ. Geol. Soc. Dublin, vol. vii. p. 7.
1888. *Goniatites intercostalis*, R. Etheridge, Brit. Foss., vol. i. Palæozoic, p. 312.

Mr. R. B. Newton considers this species to be referable to *Leveillia Puzo*, Léveillé (see Geol. Mag. [3], vol. viii. 1891, p. 205).

C. 245. Four examples, two of which are Phillips's types. Carboniferous Limestone: Bolland, Yorkshire.

Gilbertson Coll.

"Goniatites evolutus," J. Phillips.

1836. *Goniatites evolutus*, J. Phillips, Geol. Yorks. pt. ii. p. 237, pl. xx. ff. 65–68. The original of f. 64 (and probably also of ff. 67 & 68) is in the York Museum.

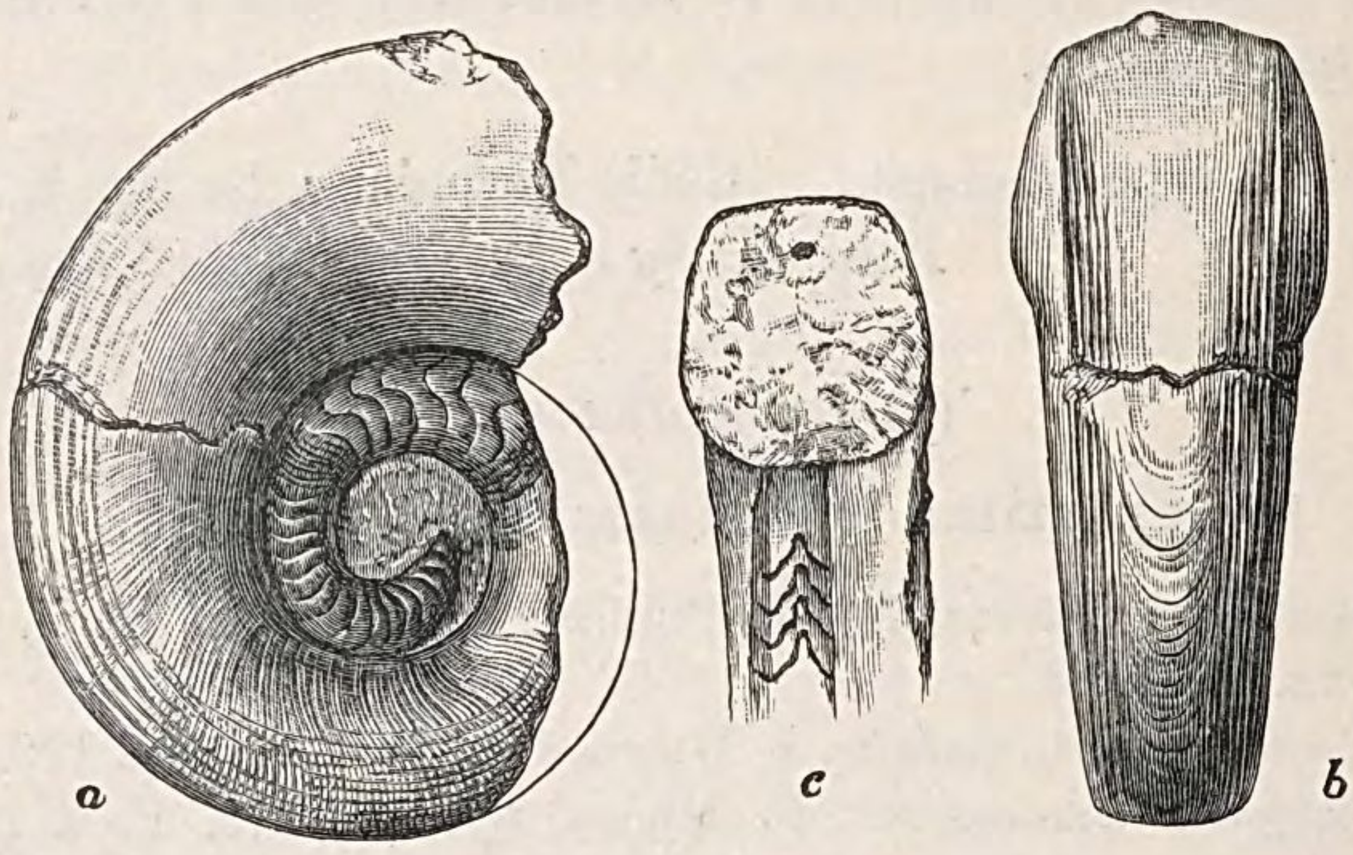
(For references and synonymy see Geol. Mag. [4], vol. iii. 1896, p. 419.)

This species is referable to the genus *Subclymenia* (*S. evoluta*) (see Geol. Mag. [4], vol. iii. 1896, p. 413). It is represented in the Collection by two examples.

C. 214. The first half whorl of an example, showing the delicate cancellated sculpture of the initial portion of the shell; locality not recorded, probably Yorkshire.

Gilbertson Coll.

Fig. 139.



Subclymenia evoluta.—*a*, lateral aspect; *b*, peripheral aspect; *c*, front view with the outer portion detached, showing the position of the siphuncle and the form of the peripheral lobe of the suture-line at the end of the first whorl.

C. 5336. The example figured in Geol. Mag. [4], vol. iii. 1896, p. 417 woodc.; locality not recorded, probably Yorkshire. (See fig. 139.)

Gilbertson Coll.

SUPPLEMENT.

Genus **BACTRITES,** G. Sandberger.

[See *suprà*, p. 1.]

Bactrites carinatus, G. & F. Sandberger.

[See *suprà*, p. 8.]

C. 5928. Four fragments. Upper Devonian (Domanik-Schichten): River Uchta, tributary of River Ishma, Govt. Archangel, Petschora-Land, Russia. *Purchased*, 1896.

Genus **CLYMENIA,** Münster, emend. Gümbel.

[See *suprà*, p. 14.]

The following specimens may be referred to *Clymenia* with much probability of correctness:—

C. 600 a, b. Two examples in water-worn nodules, polished; Labrador Tea Gardens, Teignmouth, Devon.
Presented by John Edward Lee, Esq., 1885.

Genus **MIMOCERAS,** A. Hyatt.

[See *suprà*, p. 33.]

Add as synonyms:—

Gyroceratites, H. v. Meyer, 1831 [1]; *id.*, H. G. Bronn, 1837 [2]; *Spirula*, Goldfuss, 1832 [3]; *Ammonites*, H. E. Beyrich, 1837 [4] (pars), et auct.; *Goniatites*, d'Archiac & de Verneuil, 1842 [5] (pars), et auct.; *Lituites*, F. A. Quenstedt, 1849 [6] (pars); *Aphyllites*, E. v. Mojsisovics, 1882 [7] (pars).

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[1] Nova Acta Acad. Leop.-Carol. vol. xv. pt. 2, p. 73.
[2] Lethæa Geogn. 2nd ed. vol. i. p. 102.
[3] In von Dechen's Handb. de Geognosie von H. T. de la Beche, p. 536.
[4] De Goniatitis in montibus rhenanis occurrentibus, p. 5.
[5] Trans. Geol. Soc. [2], vol. vi. p. 2, p. 338.
[6] Petrefact. Deutsch. vol. i. Cephalopoden, p. 64.
[7] Abhandl. d. k.-k. geol. Reichsanst. vol. x. p. 181, footnote.

Genus **ANARCESTES,** E. v. Mojsisovics.

[See *suprà*, p. 38.]

Add as synonyms:—

Ammonites, L. v. Buch, 1832 [1] (pars), et auct.; *Goniatites*, d'Archiac & de Verneuil, 1842 [2] (pars), et auct.; *Aganides*, A. d'Orbigny, 1850 [3] (pars).

Anarcestes lateseptatus (Beyrich).

[See *suprà*, p. 38.]

To references add:—

1880. *Goniatites lateseptatus*, W. Branco, Palæontogr. vol. xxvii. pl. vi. ff. v. *a–e* [development of suture-line].

Anarcestes cancellatus, d'Archiac & de Verneuil.

[See *suprà*, p. 47.]

C. 1842 c. An example, 29 mm. in diameter, probably referable to this species; Adorf, Waldeck.

Presented by John Edward Lee, Esq., 1885.

Anarcestes, sp.

C. 4643. The pyritized inner whorls of an example up to a diameter of 3·5 mm., showing the suture-lines and the initial chamber. Devonian: Trevone, Cornwall. (See paper by C. Howard Fox, F.G.S., "On some fossils from the coast sections in the parishes of Padstow and St. Merryn," Trans. Roy. Geol. Soc. Cornwall, vol. xi. pt. ix. 1895, pp. 634–644.)

Presented by C. Howard Fox, Esq., 1894.

Genus **AGONIATITES,** F. B. Meek.

[See *suprà*, p. 49.]

To synonyms of the genus add:—

Ammonites, L. v. Buch, 1832 [4] (pars), et auct.; *Goniatites*, J. Phillips, 1841 [5] (pars), et auct.; *Aganides*, A. d'Orbigny, 1850 [6] (pars).

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[1] Abhandl. d. Akad. Wissensch. Berlin, for 1830, pp. 166, 167.
[2] Trans. Geol. Soc. [2], vol. vi. pp. 337–339.
[3] Prod. de Paléont. stratigr. vol. i. p. 58 *et seqq.*
[4] Phys. Abhandl. d. Akad. Wissensch. Berlin, for 1830, p. 165.
[5] Pal. Foss. Cornwall, Devon, and W. Somerset (Mem. Geol. Surv.), p. 140.
[6] Prod. de Paléont. stratigr. vol. i. p. 58 *et seqq.*

Agoniatites costulatus, d'Archiac & de Verneuil, sp.

1842. *Goniatites costulatus*, d'Archiac & de Verneuil, Trans. Geol. Soc. [2], vol. vi. p. 341, pl. xxvi. ff. 3, 3 *a*, 3 *b*.

? 1850. *Goniatites costulatus*, F. A. Roemer, Palæontogr. vol. iii. p. 28, pl. iv. f. 16.

1850. *Aganides costulatus*, A. d'Orbigny, Prod. de Paléont. stratigr. vol. i. p. 58.

1852. *Ammonites* (*Goniatites*) *costulatus*, C. G. Giebel, Fauna der Vorwelt, vol. iii. p. 750.

1889. *Goniatites inconstans* (pars), G. F. Whidborne, Devon. Fauna S. England (Mon. Pal. Soc), pt. 2, p. 63.

1895. *Agoniatites inconstans*, var. *costulatus*, E. Holzapfel, Abhandl. d. k. Preuss. geol. Landesanst., n. f. Heft 16, p. 63, pl. vi. f. 2; pl. viii. f. 5.

Sp. Char. Shell of medium size, discoidal, widely umbilicated; greatest thickness near the umbilicus, about one-fourth of the diameter of the shell; height of outer whorl about one-half of the diameter of the shell. Whorls rather numerous; inclusion about one-half; umbilicus wide, rather more than one-fifth of the diameter of the shell. Whorl elongate-oval in section, about twice as high as wide; indented to about two-sevenths of its height by the preceding whorl; periphery wide, flattened, bordered by two narrow and shallow channels; sides feebly convex, converging; inner area steep, flattened or slightly concave. Body-chamber (? length); chambers (? depth); suture-line as in fig. 140. Test of medium-

Fig. 140.

Suture-line of *Agoniatites costulatus*; reduced to two-thirds of the natural size. After Holzapfel.

sized shell ornamented with numerous "(twenty-eight to thirty) simple ribs, [which] set off from the suture, take a backward direction across half the side, where they are more prominent, then rise again towards the dorsal [peripheral] channel, becoming attenuated so as to disappear completely upon the outer edge of each channel. Besides these ribs, there are fine undulated striæ, which, after going forward to the dorsal channels, turn backward to form a sinus which occupies the whole width of the back [periphery]." With age the ribs disappear, and then the growth-lines become obsolete or very indistinct.

In immature examples the whorls are relatively thicker and the umbilicus wider than in the adult.

Size. Holzapfel figures (*op. cit.* pl. vi. f. 2) an example 74 mm. in diameter.

Form. & Loc. Middle Devonian: Adorf, Waldeck.

C. 2118 k. An imperfect distorted specimen, about 25 mm. in diameter. *Presented by John Edward Lee, Esq.*, 1885.

Agoniatites verna-rhenanus (F. Maurer).

1876. *Goniatites verna-rhenanus*, F. Maurer, Neues Jahrb. p. 821, pl. xiv. ff. 1 *a*, *b*, *c*.
1878. *Goniatites evexus* (pars), E. Kayser, Abhandl. geol. Specialkarte Preussen, &c. vol. ii. pt. iv. p. 58.
1884. *Goniatites verna-rhenanus*, E. Kayser, Jahrb. d. k. Preuss. geol. Landesanst. u. Bergakad. for 1883, p. 51, pl. vi. ff. 1–7.
1885. *Goniatites verna-rhenanus*, E. Waldschmidt, Zeitschr. deutsch. geol. Gesell. vol. xxxvii. p. 918.

Sp. Char. Shell discoidal, compressed, umbilicated; greatest thickness at the umbilical margin, about one-third of the diameter of the shell; height of outer whorl about one-half of the diameter of the shell. Whorls three or four; inclusion two-thirds; umbilicus deep, rather more than one-fifth of the diameter of the shell in width, exposing the edges of the inner whorls. Whorl elliptical in section, higher than wide; indented to about one-fourth of its height by the preceding whorl; periphery feebly convex, with subangular margins, and a shallow furrow near each margin; sides feebly convex, especially their outer portion, with a broad shallow furrow near the margin of the periphery; inner area narrow, imperfectly defined, sloping towards the umbilicus. Body-chamber occupying probably one-half of a whorl. Chambers shallow, about ten or eleven in the last half whorl of the septate portion; suture-line as in fig. 141. Test ornamented with delicate striæ, which

Fig. 141.

Suture-line of *Agoniatites verna-rhenanus*; drawn of the natural size from the specimen in the Collection.

form a broad shallow forwardly-concave curve on the lateral area, and are abruptly recurved near the margin of the periphery, where they form a rather deep sinus.

Size. Shell attaining a diameter of about 55 mm.

Form. & Loc. Lower Devonian (Orthoceras-Schiefer): Olkenbach, N.E. of Wittlich, Rhenish Prussia.

C. 5936. One pyritized example, 45 mm. in diameter, in matrix, displaying the suture-lines and ornaments of the test.

Presented by Upfield Green, Esq., 1897.

The following specimen is possibly referable to this genus (*Agoniatites*):—

C. 1575. A polished slab exhibiting median section of a *Goniatite*; the specimen is elliptical, its diameters being 210 and 150 mm. respectively. Devonian: "found in the old Pier, Torquay—the stone said to have come from Daddy Hole Quarry."

Presented by John Edward Lee, Esq., 1885.

Genus **GEPHYROCERAS,** A. Hyatt.

[See *suprà*, p. 59.]

Add to synonyms:—

Ammonites, L. v. Buch, 1832 [1] (pars), et auct.; *Goniatites*, d'Archiac & de Verneuil, 1842 [2] (pars), et auct.; *Aganides*, A. d'Orbigny, 1850 [3] (pars).

Gephyroceras intumescens (Beyrich).

[See *suprà*, p. 62.]

C. 5774. An example, about 24 mm. in diameter, in matrix. Upper Devonian; Lower Dunscombe, near Chudleigh, S. Devon.

Presented by John Edward Lee, Esq., 1885.

C. 5929. One well-preserved specimen, 48 mm. in diameter, labelled "*Goniatites* (*Manticoceras*) *Ammon*, Keys." Upper Devonian (Domanik-Schichten): River Uchta, tributary of the River Ishma, Govt. Archangel, Petschora-Land, Russia.

Purchased, 1896.

Gephyroceras orbiculus (Beyrich).

[See *suprà*, p. 75.]

C. 4839. Well-preserved example, 9·5 mm. in diameter, showing the suture-line and the initial-chamber: Upper Devonian; Büdesheim, Eifel.

Presented by E. H. L. Schwarz, Esq., 1894.

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[1] Phys. Abhandl. d. k. Akad. d. Wissensch. Berlin, for 1830, p. 181.

[2] Trans. Geol. Soc. [2], vol. vi. p. 338.

[3] Prod. de Paléont. stratigr. vol. i. pp. 58-61.

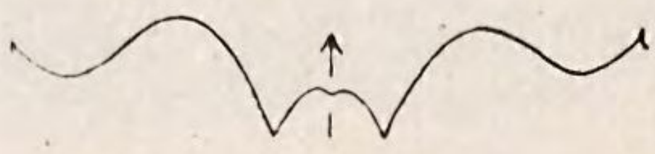
Gephyroceras Keyserlingi (C. G. Giebel).

[See *suprà*, p. 80.]

1844. *Goniatites bisulcatus*, A. v. Keyserling, Verhandl. Russ.-Kais. Mineral. Gesell. p. 235, pl. A. fig. 7.
1846. *Goniatites bisulcatus*, A. v. Keyserling, Petschora-Land, p. 282, pl. xii. f. 7.
1850. *Aganides bisulcatus*, A. d'Orbigny, Prod. de Paléont. stratigr. vol. i. p. 61.
1852. *Ammonites Keyserlingi*, C. G. Giebel, Fauna der Vorwelt, vol. iii. p. 468.
1884. *Manticoceras bisulcatum*, A. Hyatt, Proc. Boston Soc. Nat. Hist. vol. xxii. p. 318
1887. *Goniatites* (*Manticoceras*) *bisulcatus*, Th. Tschernyschew, Mém. Com. Géol. St. Pétersbourg, vol. iii. no. 3, p. 23, pl. ii. f. 4.

Sp. Char. Shell rather small, discoidal, much compressed, widely umbilicated; greatest thickness at a short distance from the inner edge of the whorl, about two-sevenths of the diameter of the shell; height of outer whorl rather more than one-third of the diameter of the shell. Whorls four or five; inclusion nearly one-half; umbilicus shallow, about one-third of the diameter of the shell in width, partly exposing the inner whorls. Whorl elliptical in section, compressed, higher than wide; slightly indented by the preceding whorl; periphery narrowly convex; sides feebly convex, flattened, and passing imperceptibly into the inner area which slopes towards the umbilicus, with a shallow spiral groove near the periphery. Body-chamber occupying about half a whorl. Chambers rather deep; suture-line as in fig. 142. Test very thin, ornamented

Fig. 142.



Suture-line of *Gephyroceras Keyserlingi*. Drawn from a specimen in the British Museum Collection, and enlarged three times.

with very delicate striæ, which form a rather deep forwardly-concave sinus on the side, are projected considerably forward near the periphery and turning abruptly backward form on the periphery a deep linguiform sinus.

On page 80 of the present Catalogue we used the name *bisulcatus* for a species of *Gephyroceras* described by Roemer from the Hartz. Now Giebel regarded Keyserling's *G. bisulcatus* as identical

with Roemer's, and referred the species to *Ammonites*, but the name *bisulcatus* having already been used for an Ammonite he designated the species *Keyserlingi*. Although both forms are referable to the same subdivision of *Goniatites*, they are, however, specifically distinct. We have therefore retained the name *Gephyroceras bisulcatum* for Roemer's species, and for Keyserling's species we have adopted Giebel's name *Keyserlingi*.

Size. Shell attaining a diameter of about 18 mm.

Form. & Loc. Domanik-Schichten (Upper Devonian): River Uchta, tributary of the River Ishma, Govt. Archangel, Petschora-Land, Russia.

C. 5926. Two well-preserved specimens, 16 and 18 mm. in diameter respectively. *Purchased*, 1896.

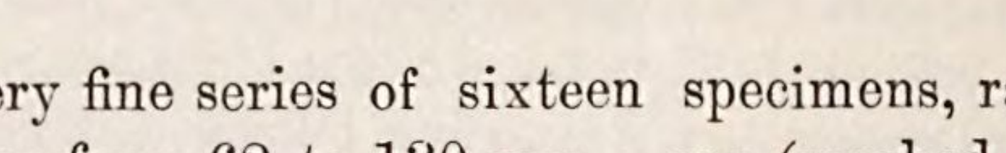
Gephyroceras acutum (A. v. Keyserling).

1844. *Goniatites acutus*, A. v. Keyserling, Verhandl. Russ.-Kais. Mineral. Gesell. p. 232, pl. A. ff. 6, 6 *a*, 6 *b* (*not* of Münster).
1846. *Goniatites acutus*, A. v. Keyserling, Petschora-Land, p. 280, pl. xii. ff. 6, 6 *a*, 6 *b*.
1848. *Goniatites acutus* (pars), H. G. Bronn, Gesch. d. Natur, vol. iii. p. 540.
1850. *Aganides acutus* (pars), A. d'Orbigny, Prod. de Paléont. stratigr. vol. i. p. 58.
1852. *Ammonites acutus* (pars), C. G. Giebel, Fauna der Vorwelt, vol. iii. p. 468.
1882. *Timanites acutus*, E. v. Mojsisovics, Abhandl. d. k.-k. geol. Reichsanst. vol. x. p. 183.
1884. *Goniatites acutus*, A. Krasnopolski, Bull. Com. géol. St. Pétersbourg, vol. iii. no. 4, p. 123.
1884. *Gephuroceras acutum*, A. Hyatt, Proc. Boston Soc. Nat. Hist. vol. xxii. p. 317.

Sp. Char. Shell discoidal, much compressed, lenticular; greatest thickness at about one-third of the height of the whorl from the umbilicus, nearly two-ninths of the diameter of the shell; height of outer whorl about four-sevenths of the diameter of the shell. Whorls few; inclusion complete; umbilicus closed, depressed. Whorl sagittate in section, nearly three times as high as wide; indented to about two-fifths of its height by the preceding whorl; periphery acute; sides feebly convex; no distinct inner area. Body-chamber occupying one-half of the outer whorl. Chambers very shallow, about seventeen in the last half whorl of the septate

portion; suture-line as in fig. 143. Test almost smooth, with delicate distant striæ, which are waved on the sides and form a

Fig. 143.



Suture-line of *Gephyroceras acutum*. Drawn from a specimen in the British Museum Collection, and reduced to two-thirds of the natural size.

deep, fairly acute sinus on the periphery; near the umbilicus these striæ are collected into prominent bundles with interspaces of about their own width. 'Wrinkle-layer' composed of very minute irregular anastomosing rugæ.

Size. The largest specimen in the Collection was, when complete, about 130 mm. in diameter.

Form. & Loc. Upper Devonian (Domanik-Schichten): River Uchta, tributary of the River Ishma, Govt. Archangel, Petschora-Land, Russia.

C. 5924. A very fine series of sixteen specimens, ranging in diameter from 62 to 130 mm.; one (marked *a*) exhibits the 'wrinkle-layer' very clearly. *Purchased*, 1896.

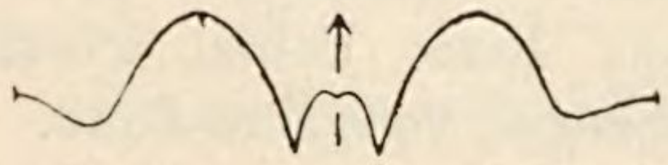
Gephyroceras Uchtense (A. v. Keyserling).

1844. *Goniatites Uchtensis*, A. v. Keyserling, Verhandl. Russ.-Kais. Mineral. Gesell. p. 236, pl. B. ff. 1 *a–c*.
1845. *Goniatites Uchtensis*, de Verneuil, in Murchison, de Verneuil, and de Keyserling, Géol. Russie d'Europe, vol. ii. p. 394.
1846. *Goniatites Uchtensis*, A. v. Keyserling, Petschora-Land, p. 282, pl. xiii. ff. 1 *a–c*.
1848. *Goniatites Uchtensis*, H. G. Bronn, Gesch. d. Natur, vol. iii. p. 546.
1850. *Aganides Uchtensis*, A. d'Orbigny, Prod. de Paléont. stratigr. vol. i. p. 61.
1852. *Ammonites Uchtensis*, C. G. Giebel, Fauna der Vorwelt, vol. iii. p. 468.

Sp. Char. Shell discoidal, much compressed, umbilicated; greatest thickness at about the middle of the lateral area, about two-ninths of the diameter of the shell; height of outer whorl about two-fifths of the diameter of the shell. Whorls five or six; inclusion two-thirds; umbilicus about two-sevenths of the diameter of the shell in width, shallow, exposing a portion of the inner whorls. Whorl lanceolate in section, much higher than wide; indented to about one-fourth of its height by the preceding whorl; periphery rather

acute, bevelled on either side; sides much flattened, feebly convex, passing imperceptibly into the inner area. Body-chamber occupying rather more than half a whorl. Chambers shallow, about twenty-five in a whorl of 20 mm. diameter; suture-line as in fig. 144.

Fig. 144.



Suture-line of *Gephyroceras Uchtense*.
After v. Keyserling.

Test with very fine striæ, which form a fairly deep forwardly concave sinus on the side, are projected considerably forward near the periphery, then turning abruptly backward form a deep forwardly-concave sinus on the periphery; the sides also with slight folds following the direction of the striæ.

Size. Shell attaining a diameter of a little more than 45 mm.

Form. & Loc. Domanik-Schichten (Upper Devonian): River Uchta, tributary of the River Ishma, Govt. Archangel, Petschora-Land, Russia.

C. 5931. One well-preserved example, 43 mm. in diameter, rather more widely umbilicated than represented in Keyserling's figure. *Purchased*, 1896.

Genus **TORNOCERAS,** A. Hyatt.

[See *suprà*, p. 91.]

To the synonyms of the genus add :—

Ammonites, L. v. Buch, 1832 [1] (pars), et auct.; *Goniatites*, G. Münster, 1832 [2] (pars), et auct.; *Aganides*, A. d'Orbigny, 1850 [3] (pars).

Tornoceras simplex (v. Buch).

[See *suprà*, p. 107.]

To the references to this species add :—

1880. *Goniatites retrorsus*, var. *typus*, W. Branco, Palæontogr. vol. xxvii. pl. v. ff. vii. *a–l*.

To description of the species add :—" Initial-chamber spheroidal, somewhat transversely-elongate."

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[1] Phys. Abhandl. d. k. Akad. Wissensch. Berlin, for 1830, p. 174.
[2] Ueber Planul. & Goniat. p. 18 *et seqq*.
[3] Prod. de Paléont. stratigr. vol. i. p. 58 *et seqq*.

Since the description of this species was printed off the following specimens have been added to the Collection :—

C. 5925. An excellent series of twenty-seven specimens, labelled "*Goniatites* (*Tornoceras*) *retrorsus*, v. Buch," showing the various characters of the species, and ranging from 15·5 to 71 mm. in diameter. Upper Devonian (Domanik-Schichten): River Uchta, tributary of River Ishma, Govt. Archangel, Petschora-Land. *Purchased*, 1896.

C. 5932. Three examples, ranging in diameter from 20 to 42·5 mm., more inflated than the above; they are labelled "*Goniatites* (*Tornoceras*) *simplex*, v. Buch." Upper Devonian (Domanik-Schichten): River Uchta, tributary of River Ishma, Govt. Archangel, Petschora-Land.

Purchased, 1896.

Tornoceras curvispina (G. & F. Sandberger).

1850–56. *Goniatites retrorsus*, var. *curvispina*, G. & F. Sandberger, Verstein. rhein. Schichtensyst. Nassau, pp. 100, 108, pl. x. ff. 2, 2 *a–c*; pl. x^{b}. ff. 9, 10, 24, 28.

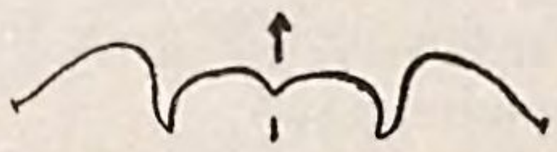
1851. *Goniatites retrorsus*, var. *curvispina*, G. Sandberger, Jahrb. natur. Verein. Nassau, vol. vii. pts. 2 & 3, p. 297, pl. ii. f. 17.

1873. *Goniatites curvispina*, E. Kayser, Zeitschr. deutsch. geol. Gesell. vol. xxv. p. 625.

1887. *Goniatites* (*Tornoceras*) *curvispina*, F. Frech, Zeitschr. deutsch. geol. Gesell. vol. xxxix. p. 439.

Sp. Char. Shell usually small, inflated; greatest thickness near the middle of the lateral area, about two-thirds of the diameter of the shell; height of outer whorl rather more than one-half of the diameter of the shell. Whorls (? number); inclusion complete; umbilicus closed, depressed. Whorl horseshoe-shaped in section, a little wider than high; indented to nearly one-half of its height by the preceding whorl; periphery broadly convex and continuous with the convex sides, which are depressed at the umbilicus and form no distinct inner area. Body-chamber occupying at least three-fourths of the outer whorl; aperture not seen. Chambers shallow; suture-line as in fig. 145. Test ornamented with fine

Fig. 145.



Suture-line of *Tornoceras curvispina*; enlarged.
After Sandberger.

striæ, which are directed backwards on the sides and form a forwardly-concave sinus on the periphery. The outer whorl with

from two to four constrictions concurrent with the fine striæ of the test, these are deepest on the periphery.

Size. G. & F. Sandberger figure an example 29 mm. in diameter.

Form. & Loc. Upper Devonian: Saltern Cove, near Torquay, S. Devon.

C. 1961 f. An example, 6·5 mm. in diameter, apparently belonging to this species.

Presented by John Edward Lee, Esq., 1885.

Genus **GLYPHIOCERAS**, A. Hyatt.

[See *suprà*, p. 153.]

Glyphioceras vesica (J. Phillips).

[See *suprà*, p. 178.]

73812. Three examples, ranging from 4·5 to 8·5 mm. in diameter, labelled "Devonian, S. Petherwin." The two smaller specimens are much worn, but appear to be referable to the same species as the other example. The latter is entirely septate and displays both the suture-line and the ornaments of the test; in both of these characters it agrees perfectly with *Glyphioceras vesica* (Phillips).

History unknown.

Genus **PRONORITES,** E. von Mojsisovics.

[See *suprà*, p. 260.]

Pronorites cyclolobus (J. Phillips).

[See *suprà*, p. 264.]

Delete the following references :—

1881. *Goniatites cyclolobus*, C. Barrois, Bol. Com. Map. geol. España, vol. viii. p. 8, pl. C. ff. 2 *a-c*.

1882. *Goniatites cyclolobus*, C. Barrois, Mém. Soc. géol. du Nord, vol. ii. p. 295, pl. xiv. ff. 2 *a–c*.

Karpinsky (Mém. Acad. Imp. Sci. St. Pétersbourg, [7], vol. xxxvii. No. 2, p. 10) separates Barrois' species from *Pronorites cyclolobus* (J. Phillips) under the name *Pronorites Barroisi*.

ALPHABETICAL INDEX.

[*Note.*—The numbers of pages on which merely incidental references occur are printed in italics.]

A beautiful Nautilites, 166.
Acrochordiceras, 143.
Acutolaterales, 91.
Adrianites, 268–70.
Æquales, 91.
Aganides, 14, 127, 131–2, 141, 143, 153, 212, 219, 226, 242, 245, 260, 265, 273, 284, 287, 291.
acutus, 101, 289.
æquabilis, 87.
atratus, 220.
Becheri, 249.
Belvalianus, 138.
bidorsalis, 201.
bisulcatus, 288.
Bronnii, 128.
cancellatus, 47.
carina, 225, 279.
ceratitoides, 251, 257.
complicatus, 208.
contiguus, 128.
costatus, 244.
costulatus, 285.
cyclolobus, 264.
diadema, 193, 199, 202, 203.
divisus, 133.
fasciculatus, 148.
Gilbertsoni, 220.
Henslowi, 252.
hybridus, 96.
implicatus, 180.
intumescens, 62.
Jossæ, 239, 240.
latiseptatus, 39.
linearis, 96.
Looneyi, 222, 224.
Marianus, 237.
micronotus, 173.
mixolobus, 255.
multilobatus, 274.
Aganides (*cont.*).
Münsteri, 128.
mutabilis, 182, 206.
Næggerathi, 43.
nitidus, 186.
obtusus, 169.
orbicularis, 128.
orbiculus, 75.
paucilobus, 209.
paucistriatus, 103.
planidorsatus, 113.
platylobus, 183, 184.
princeps, 145.
quadripartitus, 137.
reticulatus, 194.
rotatorius, 139, 141.
speciosus, 29.
sphæricus, 157, 158.
——, var. β. crenistria, 161.
——, var. γ. striatus, 167.
spirorbis, 213.
striatus, 160, 167.
striolatus, 202.
subbilobatus, 130.
subfurcatus, 149.
sublævis, 92, 93.
subnautilinus, 44.
subsulcatus, 136.
sulcatus, 135.
tenuistriatus, 274.
transitorius, 55.
tripartitus, 133.
truncatus, 175.
tuberculosus, 244.
Uchtensis, 290.
undulosus, 92, 93.
Verneuili, 97.
vesica, 178.
vinctus, 31.
vittiger, 215, 217

Agathiceras, 268.
(?) micromphalum, 271.
Suessi, *268*, 269.
Uralicum, 270, *272*.
Agoniatites, *33*, 49, *122*, 284, 287.
bicanaliculatus, 55.
Bohemicus, 34, 49.
costulatus, 285.
fecundus, 54.
fidelis, 50.
inconstans, var. costulatus, 285.
obliquus, 56.
occultus, 52.
tabuloides, 53.
transitorius, 55.
Vanuxemi, 57.
verna, 51.
verna-rhenanus, 286.
Ammonea trachyostraca, 17.
Ammonellipsites, 143, 244.
compressus, 252.
funatus, 147.
Ammonites, 121, 127, 131, 143, 153, 212, 219, 226, 242, 244, 260, 265, 273, 283, 284, 287, 291.
acutus, 101, 289.
æquabilis, 87.
atratus, 220, 279, *280*.
Becheri, 247, 249.
Belvalianus, 138.
bidorsalis, 201.
calculiformis, 84.
cancellatus, 47.
carbonarius, 157, 229.
carina, 225.
ceratitoides, 251.
complicatus, 208.
compressus, *33*, 35.
(Goniatites) costulatus, 285.
cyclolobus, 264.
descriptus, 128.
diadema, 202, 203.
divisus, 133.
forcipifer, 61.
Gilbertsoni, 220.
gracilis, 35.
Henslowi, *246*, 252, 254.
Hoeningnausi, 128.
implicatus, 180.
inæquistriatus, 23.
intumescens, 62.
Jossæ, 239, 240.
Keyserlingi, 288.
lamellosus, 69, 71.
lateseptatus, 38, 39.
latus, 19.
Listeri, 148, 182, 202, 229, 233, 234, 237.
Looneyi, 222, 224.
micronotus, 173.
Ammonites (*cont.*).
mixolobus, 255.
multilobatus, 274, 275.
Münsteri, 128.
mutabilis, 181.
nitidus, 186.
Noeggerati, 42, 43.
ophideus, 257.
orbiculus, 75.
paucilobus, 209.
(Goniatites) planidorsatus, 113.
platylobus, 183, 185.
primordialis, 82, 84.
princeps, *143*, 145, 147.
reticulatus, 124, 194, 199.
retrorsus, 78, 80, 96, 103, 107, 133, 135–7.
rotatorius, 139, 141.
sacer, 233.
semistriatus, 27.
serratus, 88.
simplex, 107.
speciosus, 29.
sphaericus, 157, 161.
sphæricus, 157, 167, 169, 208.
spiralis, 210.
spirorbis, 213.
striatus, 160, 166, *167*.
(Goniatites) subbilobatus, 130.
subcrenatus, 229, *231*.
subnautilinus, 42–4, 57.
terebratus, 123.
transitorius, 55.
(Goniatites) transitorius, 55.
tridens, 248.
truncatus, 175.
Uchtensis, 290.
vesica, 178, 206.
vittiger, 215, 217.
Ammonitidæ, 16.
Ammonoidea, 13.
Anarcestes, *16*, *33*, *34*, 38, *60*, *92*, 284.
cancellatus, 47, 284.
circumflexifer, 116.
lateseptatus, 38, 284.
lateseptatus ?, 34.
neglectus, 41.
Noeggerati, 34, 42.
nuciformis, 48.
plebeius, 39.
Ruppachensis, 45.
simulans, 41.
subnautilinus, 43, 44.
sp., 284.
Angustisellati, 13.
Aphyllites, 49, 283.
ambigena, 37.
Bohemicus, 49.
fecundus, 54.
fidelis, 50.

Aphyllites (*cont.*).
occultus, 52.
tabuloides, 53.
verna, 51.
Aptychus of Goniatites, 277, 278.
Arcestidæ, 270.
Asellati, 13.
Asellati ammonitiformes, 6, 7.
Asellati spiruliformes, 6, 7.
Aturia, 14, 15.

Bactrites, 1–8, *33*, *34*, 283.
Ausavensis, 10.
Büdesheimensis, 10.
carinatus, 8, 9, 283.
clavus, 9.
gracilis, *5*, 10, *11*.
Hyatti ?, 5.
obliqueseptatus, 11.
Sandbergeri, *2*, *10*.
(?) Steinhaueri, 11.
Bactritidæ, 1.
Baculites, 2, 3, 13.
Beautiful Nautilites, 166.
Belemnites, 6.
Württembergicus, 5.
Bellerophon discoides, 85.
micromphalus, 271.
Beloceras, 273.
multilobatum, 274, 275.
sagittarium, 274.
Brancoceras, *122*, 131–133, *134*, *139*, *156*.
Belvalianum, 138.
divisum, 133.
Ixion, 132, 141, *142*.
lineare, 96.
quadripartitum, 137.
rotatorium, 139, 141, *142*.
subsulcatum, 136.
sulcatum, 135.
umbilicatum, 94.
Ungeri, 130.
sp., 142.

Carbonarii, 155.
Carnites, 261.
Ceratites, *8*, 244.
Henslowi, 252.
Clymene, 15.
Clymenia, *8*, 14–18, 283.
acuticosta, 29.
angulosa, 30.
angustiseptata, 18.
annulata, 17.
arietina, *17*, 19.
binodosa, 18, 20, *30*, *32*.
bisulcata, 24, 25.
brevicostata, 19.

Clymenia (*cont.*).
campanulata, 19, 27.
cincta, 19.
cingulata, 23.
(?) complanata, 72.
compressa, 27.
cristata, 24.
dorsocostata, 27.
fasciata, 19.
flexuosa, 17.
inæquistriata, 24, *26*.
inflata, 19.
lævigata, 18, 21.
(Endosiphonites) lævigata, 22.
lævigata, var. elliptica, 23.
——, var. nana, 23.
——, var. semicingulata, 23.
——, var. semiplicata, 23.
——, var. speciosa, 23.
lata, 19.
linearis, 24, 25, *26*.
Münsteri, 20, *21*.
ornata, 27.
Otto, 24.
Ottonis, 24.
paradoxa, 32
planorbiformis, *17*, 24, 25.
plicata, 19, 27.
plurisepta, 19, *20*.
pygmæa, 24.
quadrifera, 27.
sagittalis, 19.
Sedgwicki, 24.
semicostata, 17.
serpentina, 24.
(?) solarioides, 32.
speciosa, 18, *21*, 29, *31*.
(Gonioclymenia) speciosa, 30.
spinosa, 17, 21.
striata, *17*, 18, 27.
——, var. ornata, 28.
(Oxyclymenia) striata, 27.
subarmata, *17*, 18, 31.
sublævis, 24, *26*.
sublinearis, 26.
subnodosa, 19.
tenuistriata, 24.
undulata, 23, 26.
(Oxyclymenia) undulata, 25.
Clymenidæ, 14, *33*.
Clymeninæ, 17.
Conchyliolithus N. Ammonites (Listeri), 233.
Conchyliolithus Nautilites sphæricus, 157.
Cosmoceras ornatum, 5.
Crenati, 59.
Cryptoclymenia, 18.
Cycloclymenia, 18.
Cycloclymeniæ, 17.

Cymaclymenia, 18.
Cymaclymenidæ, 18, 19.
Cyrtoceras cornu, 5.
Cyrtoclymenia, 18.
Cyrtoclymenidæ, 18, 19.

Dimorphoceras, *157*, *213*, 219, *225*.
carina, 225.
discrepans, 222, *224*.
Gilbertsoni, 220, *226*.
Looneyi, 222, 224.
Dinarites, 17.
Diptychoceras, 13.
Discites, 245.
compressus, 253.
Noeggerati, 42.
Discoclymenia, 18.

Ellipsolites, 153, 244.
compressus, *246*, 252, 254.
ovatus, 169, 171.
Ellipsolithes, 143.
funatus, 147.
Endoceras, 8.
Endosiphonites, 14, *15*.
carinatus, 24.
lævigatus, 22.
minutus, 24.
Euclymeniæ, *17*, 18.

Gastrioceras, *155*, 226, *272*.
carbonarium, 229, *235*.
coronatum, 236.
diadema, 203.
fasciculatum, 148.
Gibsoni, 194.
Jossæ, 227, *228*, 239, *241*.
Listeri, *228*, *230–2*, 233, *237*.
Marianum, *228*, 237.
sosiense, *241*.
Suessi, 240.
Geisonoceras, 3.
Genufracti, 155.
Gephuroceras *v.* **Gephyroceras.**
Gephyroceras, 59-61, *128*, *156*, 287.
acutum, 289.
æquabile, *79*, 87.
affine, 82.
bisulcatum, 80, *288–9*.
calculiforme, *60*, 84, 85.
carinatum, 81.
complanatum, 72, *76*.
forcipifer, 61.
iutumescens, 62, 69, *70*, 277, 287.
Gephyroceras (*cont.*).
intumescens, with Aptychus *in situ*, 277.
Keyserlingi, 288.
Koeneni, 81, *84*.
lamed, var. cordatus, 75.
lamellosum, 69, *72*, *86*.
orbiculus, *73*, *74*, 75, 287.
planorbe, 90.
retrorsum, *76*, 78, *81*, *82*, *84*.
serratum, 88, 89.
sublamellosum, 71, *86*.
tuberculatum, 242.
Uchtense, 290.
Globites, 153.
ovatus, 169.
sphæricus, 157.
striatus, 166.
Glyphioceras, *13*, *139*, 143, *144*, 153–7, *213*, *227–8*, *231*, 293.
bidorsale, 201.
bilingue, 192.
calyx, 206.
carbonarium, 158, 229.
complicatum, 208, 227.
crenistria, *159*, 160, *166*, *179*, *259*.
Davisi, *197*, 198.
diadema, *155*, *172*, 202, *207*, *228*.
excavatum, 199.
fimbriatum, 165.
hispanicum, 190, *192*.
implicatum, *179*, 180, *212*.
inconstans, 191.
Listeri, 234.
micronotum, 156, *172*, 173.
mutabile, 181, *207*.
nitidum, 186.
obtusum, 169, *172*, *212*.
Oweni, 188.
parallelum, 189.
(?) paucilobum, 209.
Phillipsi, *154*, *169*, *170*, 172.
platylobum, 183, *186*.
princeps, 145.
reticulatum, 193, *198*.
Roemeri, 183.
sphæricum, 154, 157, *179*, *211*, *231*.
spirale, 210, *215*.
stenolobum, 184, 186.
striatum, 166.
truncatum, 175, *181*, *191*.
vesica, 178, 293.
sp., 191, 211.
Glyphioceratidæ, *33*, 131.
Goniatites, 121, 127, 131, 143, 153, 212, 219, 226, 242, 245, 260, 265, 268, 273, 283, 284, 287, 291.

Goniatites
acutolateralis, 121, 122.
acutus, *61*, 101, 102, 289.
æquabilis, 87.
(Gephyroceras) æquabilis, 87.
affinis, 82.
(Gephyroceras) affinis, 82.
ambigena, *33*, 37.
Ammon, 62.
(Manticoceras) Ammon, 287.
ammonitoides, 103.
aratus, 117.
arquatus, 29.
Artiensis, 267,
atratus, 220, *222*.
auris, 103, *104*.
(Tornoceras) auris, *92*, 103.
Ausavensis, 106.
Baylei, 210.
Becheri, 249.
(Prolecanites) Becheri, 249.
Belvalianus, *133*, 138, *139*.
(Prionoceras) Belvalianus, 138.
Beyrichianus, 202.
(Tornoceras) biarcuatus, 92.
bicanaliculatus, 55, *56*.
bidens, *127*, 128.
bidorsalis, 201.
bifer, 122.
biimpressus, 29.
bilanceolatus, *127*, 128, *129*.
bilinguis, 192.
binodosus, 20.
bisulcatus, 80, 288.
(Manticoceras) bisulcatus, 288.
Bohemicus, 49.
Bronni, 128, 129.
(Sporadoceras) Bronni, 129.
Bronnii, 128, *129*, *130*.
Browni, 183.
Buchii, 62, 89.
——, var., 88.
Bucklandi, 29.
calculiformis, 84, 85.
(Gephyroceras) calculiformis, 60, 85.
calyx, *155*, 206.
canalifer, 29, *30*.
cancellatus, 47.
(Anarcestes) cancellatus, 47.
carbonarius, 229, 231.
carina, 225, *226*, 279.
carinatus, 62, 63.
ceratitoides, 251.
cinctus, 113.
circumflexifer, 116.
(Tornoceras) circumflexus, 100.
clavilobus, 246.
clymeniæformis, 29, *257*.
complanatus, 72.

Goniatites (*cont.*).
(Gephyroceras) complanatus, 72.
complicatus, 208,
compressus, *2*, *3*, *5–7*, *33*, 34, 35, 62.
constrictus, 103.
contiguus, 128, *129*, *130*.
convolutus, 44.
costatus, *242*, 244.
costulatus, 285.
Cottai, 29, *30*.
crenistria, *154*, *155*, 160, 161, 194.
crispiformis, 47.
crispus, 46.
curvispina, 292.
(Tornoceras) curvispina, *92*, 292.
cyclolobus, *260*, 264, 293.
Decheni, 123.
delphinus, 122.
diadema, 202, 203.
discors, 62, 220.
discrepans, 222.
discus, 103, 124.
divisus, 133, 134.
dorsicosta, 88.
Eifliensis, 103, 108.
evexus, 51, 54, 55, 58, 286.
——, var. bohemica, 49.
evolutus, 282.
excavatus, *123*, 124, 199, 200.
expansus, *49*, 57, 58.
[Agoniatites] expansus, 58.
falx, 267.
fasciculatus, 148, *149*.
fecundus, *6*, 54.
fidelis, 50.
foraminosus, 218, 219.
forcipifer, 61.
(Gephyroceras) forcipifer, 61.
funatus, 147.
furcatus, 149.
Gerolsteinensis, 84.
Gerolsteinus, 85.
Gibsoni, 193, 194, *195*, 196.
Gilbertsoni, 220.
globosus, 94, *95*, 125, 126, *127*.
gracilis, 34, 35, 133.
granosus, 210.
Henslowi, 251, 252.
(Prolecanites) Henslowi, 253.
hemisphæricus, 164.
Hœningshausi, 62.
Hughesii, 118, 120.
hybridus, *92*, 96.
implicatus, 180.
impressus, 146.
incertus, 242.
inconstans, *280*, 285.

Goniatites (*cont.*).
insignis, 31, *32*.
intercostalis, 281.
intumescens, 62, 63, 72.
——, var. acutus, 62.
——, var. convexus, 62.
——, var. intermedius, 62.
(Gephyroceras) intumescens, 63.
(Manticoceras) intumescens, *60*, 63.
Ixion, *132*, *140*, 141.
Jossæ, 237–241.
(Gastrioceras) Jossæ, 238–240.
jugosus, 193, 194, *195*, 196.
Koeneni, 81.
lamed, var. calculiformis, 84, 85, 87.
——, var. complanatus, 72.
——, var. cordatus, 75.
——, var. latidorsalis, 82.
——, var. rugosus, 62.
——, var. tripartitus, 78.
lamellosus, 69, 128.
(Gephyroceras) lamellosus, 69.
lateseptatus, 39, 284.
(Anarcestes) lateseptatus, 39.
latestriatus, 248.
latus, 19.
linearis, *92*, 96, *97*, 133, 135–7.
(Brancoceras) linearis, 96.
(Tornoceras) linearis, 96.
Listeri, 203, *226*, 229, 233, 234.
——, var. Mariæ, 237, 238.
Looneyi, 222, *223*, 224.
lunulicosta, *246*, 247.
(Prolecanites) lunulicosta, 247.
Malladæ, 192.
Marianus, 237.
micromphalus, *117*, 271.
(Prolecanites?) micromphalus, 271.
micronotus, 173.
mixolobus, *245*, 254, 255.
[Prolecanites] mixolobus, 255.
molarius, 124.
Muensteri, 129.
Münsteri, 128–130.
mutabilis, *155*, 181, 182, 206.
multilobatus, 274, 275.
(Beloceras) multilobatus, 274, 275.
multiseptatus, 248.
neglectus, 41.
nitidus, *155*, 186.
Noeggerati, 42.
Nöggerathii, 43.
nuciformis, 48.
nummularius, 108.
obliquus, 56.

Goniatites (*cont.*).
obtusus, *154*, *155*, 169, 170, 172.
occultus, 52.
ophideus, 259.
orbicularis, 128, *129*.
orbiculus, 75.
(Gephyroceras) orbiculus, 75.
Orbignyanus, *266*, 267.
ovatus, 107, 108, 111, 169.
Oweni, 188.
——, var. parallela, 189.
Patersoni, 63.
paucilobus, *155*, 209, *213*.
paucistriatus, 103, *104*.
pentangularis, 281.
Petraeos, 94, *95*.
planidorsatus, *57*, 113, 114.
(Tornoceras) planidorsatus, 113.
planorbis, 90.
platylobus, *155*, 183, 185, *213*.
plebeius, *38*, 39.
postcarbonarius, 262.
(Pronorites) postcarbonarius, 262.
praepermicus, 263.
(Pronorites) praepermicus, 263.
Preslii, 29.
primordialis, 63, 75.
princeps, *143*, *144*, 145, 147.
psittacinus, 119.
quadratus, 85.
quadripartitus, 137.
reticulatus, 193, 194, *197*.
retrorsus, 78, 108, 109.
——, var. *a*, 78.
——, var. *b*, 78.
—— acutus, 101.
—— amblylobus, 97.
—— angulatus, 99.
—— auris, 103.
—— biarcuatus, 93.
—— circumflexus, 100, *117*.
——, var. curvispina, 292.
—— lingua, 108.
—— typus, 108.
——, var. typus, 291.
—— umbilicatus, 94.
—— undulatus, 103, 108, 112.
——, var. undulatus, 112, 123.
(Tornoceras) retrorsus, 292.
Roemeri, 29.
rotatorius, *132*, 139–41.
(Brancoceras) rotatorius, 140.
rotiformis, *155*, *213*, 215.
Rupbachensis, 46.
Ruppachensis, 46.
sagittarius, 274, 275.
serpentinus, 257, 258.
serratus, 88, 89.

Goniatites (*cont.*).
simplex, 108, 109.
(Tornoceras) simplex, *92*, 109, *292*.
simulans, 41.
sinuosus, 59.
Smithii, 186.
speciosus, 29.
sphæricus, 157, 158, 161, 167.
sphæroidalis, 183.
spiralis, 210.
spirorbis, *155*, *212*, 213.
[Nomismoceras] spirorbis, 213.
spurius, 29, 252.
stenolobus, *155*, 184.
strangulatus, 106.
striatulus, 108.
striatus, 160, 161, 166, 167, 210, 234.
striolatus, 202, 203.
subarmatus, 31.
subbilobatus, 130, *131*.
(Sporadoceras) subbilobatus, 130.
subcarinatus, 29, *30*.
sublævis, 92, *93*.
sublamellosus, 71.
(Gephyroceras) sublamellosus, 71.
sublobatus, 143.
subnautilinus, 42–45, *51*, *56*.
——, var. (?), 43.
——, var. convolutus, 44.
——, var. typus, 43.
——, var. vittiger, 45, 46.
subnodosus, 19.
subpartitus, 99.
——, var., 100.
(Tornoceras) subpartitus, 99.
subsulcatus, 136, *137*.
(Tornoceras) subundulatus, 114.
(——) ——, var. falcata, 115.
sulcatus, 135, *136*.
(Brancoceras) sulcatus, 135.
(Tornoceras) sulcatus, 135.
tabuloides, 53.
tenuistriatus, 274.
terebratus, *121*, *122*, 123.
transitorius, 55.
tridens, *246*, 248.
(Prolecanites) tridens, 248.
tripartitus, 78, 80, 133, 134.
—— lineatus, 133.
truncatus, 175, 176.
tuberculatus, 242.
tuberculoso-costatus, *242*, 244.
tuberculosus, *242*, 244.
Uchtensis, 290.
(Tornoceras) umbilicatus, 94.
undulatus, *94*, 112, 114.
(Tornoceras) undulatus, 112.
undulosus, 92, *94*.
Ungeri, 130.
uniangularis, 91.
Uralicus, 270.
(Glyphioceras ?) Uralicus, 270.
Vanuxemi, 58.
verna, 51.
verna-rhenanus, 286.
Verneuili, 97, 98, 100.
(Tornoceras) Verneuili, 98.
vesica, 178, *180*.
vinctum, 31.
virgatus, *143*, *144*, 146.
vittatus, 46.
vittiger, 215, 217.
Wurmii, 62.
sp., 142, 212.
(Glyphioceras ?), 268.
Goniatites, Aptychus of, 277, 278.
Goniatites, indeterminable, 278–9.
Goniatitidæ, 8, 17.
Goniatitinæ, 34.
Gonioclymenia, 18.
speciosa, 30.
Gonioclymenidæ, 18, 19.
Gyroceratites, 35, 283.
gracilis, 35.

Halorites, 143.
Hamites, 13.
Heminautilinus, 91, 92.
hybridus, 96.
Homoceras, 154, *155*, *207*.
calyx, 206.

Incertæ sedis, 279.
Indeterminable Goniatites, 278–9.
Irregulares, 242.

Juvavites, 143.

Lanceolati, 242.
Latisellati, 13.
Lecanites, 246.
Leiostraca, 13.
Leveillia, 280, 281.
bifida, 281.
Puzo, 281.
Linguati, 242.
Lituites, 283.
ellipticus, 22.
gracilis, 35.
Longobardites, 261.
Lytoceratidæ, 247.

Macrochoanites, 1.
Maeneceras, 121–3.
apertum, 126.
excavatum, 124.

Maeneceras (*cont.*).
intermedium, 125, *127*.
molarium, 124.
tenue, 123.
terebratum, 121, 123.
Magnosellares, 91.
Magnosellaridæ, 33, 91.
Manticoceras, 59, 60.
Ammon, 287.
bisulcatum, 288.
complanatum, 72.
intumescens, *60*, 63.
lamed, 75.
latidorsatum, *60*, 82.
tripartitum, 78.
Medlicottia, 265.
Artiensis, 267.
falx, 267.
Orbignyana, 266.
Melia, 2.
Keyserlingii, 9.
Steinhaueri, 12.
Meloceras
cornu, 5.
Mimoceras, 33, 34, 283.
ambigena, 37.
compressum, *2*, *3*, 34, 35, *38*.
Muensteroceras, 154, *155*.
excavatum, 199.
implicatum, 180.
Oweni, 188.
parallelum, 189.
reticulatum, 194.
truncatum, 176.
Munsteroceras *v.* **Muensteroceras.**

Nautellipsites, 153.
ovatus, 169.
Nautilidæ, 15.
Nautilini, 33.
Nautilinidæ, *16*, 33.
Nautilites, 153.
Nautilites, a beautiful, 166.
Nautilites Ammonites (Listeri), 233.
Nautilus, 14, *15*, 143, 245.
angustiseptatus, 19.
binodosus, 20.
compressus, 252.
(Discites) compressus, 252.
flexuosus, 27.
funatus, 147.
(Temnocheilus) furcatus, 149.
goniolobatus, 280.
goniolobus, 280.
inæquistriatus, 24.
lævigatus, 22.
ovatus, 169.
perplanatus, 175.
pompilius, 4.
Nautilus (Temnocheilus), 143.
Nomismoceras, 154, *155*, 212.
ornatum, 218.
paucilobus, 209.
rotiforme, 215. *218*, *259*.
spirorbis, *211*, 212, 213, *259*.
vittatum, 217.
vittiger, *216*, 217.
Norites, 261.
Nothoclymeniæ, 17, 29.

Orbulita, 153.
sphærica, 157.
striata, 166.
Orthocera, 1.
Steinhaueri, 11, 12.
Orthoceras, 2, *8*.
caduceus, 3.
elegans, 4.
Endymion, 3.
eximium, 3.
fasciolatum, 3.
obliquiseptatum, *3*, 11.
Pâris, 3.
placidum, 9.
pleurotomum, 3.
serratulum, 9.
Steinhaueri, 11, 12.
unguis, 5.
Xanthus, 3.
Orthoceratidæ, 8.
Orthoceratites, 1, 2.
Ausavensis, 10.
carinatus, 8, 9.
Oxyclymenia, 18.
striata, 28.
undulata, 25.

Paralegoceras, 228.
Parodiceras, 91, 92.
amblylobum, 97.
globosum, 94.
undulosum, 93.
Pericyclus, *13*, 143, 144, *155*, 187.
Doohylensis, 151.
fasciculatus, 148, *151*.
funatus, 147, *151*, *152*.
furcatus, 149, 150.
Kochi, *13*, *149*, *152*, *153*.
plicatilis, *148*, *152*.
princeps, 144, 145, *148*.
virgatus, 144, 146.
sp., 152.
Pharciceras, 245, *246*.
tridens, 248.
Pinacoceras, 273.
multilobatum, 274.
Pinacoceratidæ, 267.
Planites, 244.
compressus, 252.

Planulites, 14.
angustiseptatus, 18.
compressus, 27.
inæquistriatus, 23.
inflatus, 18.
lævigatus, 21.
linearis, 23.
pygmæus, 23.
serpentinus, 24.
striatus, 27.
——, var. costellatus, 27.
——, var. planus, 27.
——, var. semistriatus, 27.
——, var. umbilicatus, 27.
undulatus, 23.
Platyclymenia, 18.
Primordiales, 59.
PRIMORDIALIDÆ, *33*, 59.
Prionoceras, 131, *133*, *134*, *139*.
Belvalianum, 138.
divisum, 133.
Prolecanites, *213*, 244, *261*, *269*, *272*.
Becheri, 249.
ceratitoides, 251, *257*, *259*.
compressus, 245, *251*, 252, *260*.
discoides, 256.
discus, 257.
Henslowi, 252, 253.
lunulicosta, 247, *250*.
mixolobus, 245, 254, *258*, *265*.
serpentinus, 257.
similis, 259.
tridens, 248, *250*.
PROLECANITIDÆ, *33*, 242, *247*, *267*, *270*.
Prolobites, 123.
Pronorites, 260, *272*, 293.
Barroisi, 293.
cyclolobus, 261, 264, 293.
mixolobus, 255.
Phillipsi, 254.
postcarbonarius, 262.
——, var. tetragonus, 262.
——, var. vulgaris, 262.
praepermicus, 263.
sp. indet., 263.
Ptychoceras, 13.

Sageceras, *261*, 265, *266*.
Artiensis, 267.
Sandbergeroceras, 242, 244, *246*, *272*.
tuberculoso-costatum, 244.
Scaphites, 13.
Schistoceras, 270.
Sellaclymenia, 18.
Serrati, 242.
Simplices, 91.
Spirula, *6*, *7*, 283.
compressa, 35.
Sporadoceras, *122*, 127.
bidens, 129.
bilanceolatum, 129.
Bronni, 129.
contiguum, 129.
Muensteri, 127, 128.
orbiculare, 129.
subbilobatum, 130.
Stenoceras, 2.
Subclymenia evoluta, 282.

Temnocheilus, 143.
furcatus, 149.
Thalassoceras, *156*, *157*, *225*.
Looneyi, 224.
Timanites, 59, 61.
acutus, 289.
Tirolites, 17.
rectangularis, 13.
Tornoceras, 91, 92, *156*, 291.
acutum, 101.
aratum, 117.
auris, *92*, 103, *110*, 112, *114*.
Ausavense, 106.
biarcuatum, 92.
Brilonense, 117.
circumflexifer, 116.
circumflexiferum, 116.
circumflexum, 100, *102*, *107*, *115*.
curvispina, *92*, 292.
globosum, 94.
Hughesii, 118.
lineare, 96.
planidorsatum, 113.
psittacinum, 119.
retrorsum, 292.
——, var. typus, 108.
——, var. undulatus, 108.
Sandbergeri, 112, *115*.
simplex, 69, *92*, *93*, 107, 109, *112*, 118, 120, 291, *292*.
subpartitum, 99.
subundulatum, 114.
——, var. falcata, 115.
sulcatum, 135.
umbilicatum, 94.
undulosum, 92.
uniangulare, 91.
Verneuili, 97, 98, *100*, *102*, *107*
Whidbornei, 120.
Trachyostraca, 13.
Trematoceras, 2.
Triainoceras, 242, 243, *246*.
costatum, 244.
Trocholites, 14.
angustiseptata, 19.
cincta, 19.
lævigata, 22.
Tropitidæ, 157.
Turrilites, 13.

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W. H. FLOWER,
Director.

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